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An Evaluation of the Status of Hazardous Waste Management in Region X

Battelle Memorial Inst, Richland, Wash Pacific Northwest Labs

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Michael W. Stradley, Gaynor W. Dawson, Bruce W. Cone

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AN EVALUATION OF THE STATUS OF HAZARDOUS WASTE MANAGEMENT IN REGION X

by

Michael W. Stradley
Gaynor W. Dawson
Bruce W. Cone

CONTRACT 68-01-2943
Project Officer
Tobias Hegdahl

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Prepared for

SOLID WASTE BRANCH, REGION X
U. S. ENVIRONMENTAL PROTECTION AGENCY
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98901

PACIFIC NORTHWEST LABORATORIES
a division of
BATTELLE MEMORIAL INSTITUTE
P. O. Box 999
Richland, Washington 99352

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Appreciation is also extended to the numerous state and municipal officials who provided valuable inputs to the study and the hundreds of industries in Region X without whose cooperation the study would not have been possible.

ABSTRACT

Hazardous waste types, quantities, locations, and management practices for industrial, agricultural, and public operations in EPA Region X were surveyed during the research program. The objective of the study was to obtain a high resolution assessment of hazardous waste management in the states of Alaska, Idaho, Oregon, and Washington. The survey revealed that hazardous waste management practices in the region ranged from the environmentally unacceptable to the commendable. The latter situation is due in no small part to the existance of waste processing firms which collect and process hazardous wastes into marketable products and efforts by industries to recycle wastes through secondary markets.

Problems associated with the definition of hazardous wastes lead to the adoption of a dual system for determining whether or not a particular waste should be classified as being hazardous. A criteria approach using a waste decision model, developed by Battelle-Northwest, was used in conjunction with a listing approach based on the EPA proposed list of non-removable hazardous substances. Wastes that qualify as being hazardous under either of these approaches are designated potentially hazardous and are reported as such. Use of this conservative approach may lead to an over estimation -- the actual quantity of hazardous waste generated in the region may well be somewhat less than the 130 thousand metric tons reported herein.

The report also documents the activities of hazardous waste handling, processing, and disposal companies within the region and the roles of state and federal agencies in the overall management of hazardous wastes. The need for additional hazardous waste disposal sites in the region is explored and recommendations for the location of such a site are offered. Recommendations for state management programs and interstate cooperation in the area of hazardous waste management are also made.

This report was submitted in fulfillment of Contract No, 68-01-2943 under the sponsorship of the Solid Waste Management Program, Region X, U. S. Environmental Protection Agency.

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I. SUMMARY AND CONCLUSIONS

SUMMARY

The study represents an attempt to identify, locate, and quantify hazardous wastes generated in EPA Region X which encompasses the States of Alaska, Idaho, Oregon, and Washington. In the absence of a universally accepted and technically adequate definition, hazardous wastes are defined in two ways in order to insure comprehensive coverage. When sufficient data on individual wastes are available, the Battelle waste decision model, described in Appendix B, is used to determine whether or not the waste is potentially hazardous. In the absence of sufficient data on the waste constituency and concentration, any waste known to contain a designated hazardous substance is also included. Designated hazardous substances are listed in Appendix A.

Aside from the above objectives, the study is also concerned with the management practices associated with the identified wastes. This concern includes not only the management practices at the waste generating facilities, but also those of regional operations engaged in the handling, processing, and disposal of hazardous wastes. The assessment of hazardous waste management also includes a discussion of the roles of state and federal regulatory agencies within the region.

Efforts to locate additional hazardous waste disposal sites are reviewed and recommendations on the need for such additional sites are offered. The possibility of interstate cooperation in siting hazardous waste sites is explored along with other cooperative concepts applicable to more effective management of hazardous wastes within the region.

Agricultural Hazardous Wastes

Agricultural hazardous wastes in the form of spent pesticide containers were estimated for the States of Idaho, Oregon, and Washington. No data were available for a similar effort in Alaska.

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Disposal practices associated with these containers were not estimated directly, but can be inferred from previous studies by state and federal agencies. The general conclusion is that most of these containers are not receiving triple rinses before disposal and that many are being dumped in public landfills or on private land.

Industrial Hazardous Wastes

Regional industries with the potential to generate hazardous waste were initially identified by crossing state manufacturing directories with a previously generated listing of industry types which, by the nature of their operation, could produce hazardous wastes. This crossing was done on the basis of Standard Industrial Classification (SIC) and resulted in a list of approximately 2,500 industries. This list was augmented by inputs from state and local agencies. The end product, representing the universe of potential industrial hazardous waste generators, was then crossed with a variety of information sources such as state hazardous waste surveys, NPDES permits, national hazardous waste studies, municipal records, reports from waste processing companies and the technical literature in order to segregate "potentials" into actual, questionable, and non-hazardous waste generators. Those operations identified as actual or questionable generators were contacted by phone and/or letter in order to determine as precisely as possible the types and quantities of hazardous wastes associated with their operation and the management practices employed. Cooperation from industry within the region was quite good. Less than one percent of the firms contacted declined to discuss their hazardous wastes.

Hazardous Wastes From State and Federal Agencies

State and federal agencies in the region were surveyed by direct telephone and mail correspondance. Agencies reporting hazardous wastes included the following:

- Bonneville Power Administration (BPA)
- Bureau of Land Management
- U. S. Energy Research and Development Administration
- U. S. Forest Service
- U. S. Air Force
- U. S. Navy

State and Federal Regulatory Agencies

State agencies in all four states are actively involved in hazardous waste management and planning. Four separate pieces of hazardous waste legislation have been enacted in Oregon, and Washington is presently exploring the need for similar legislation. Oregon, Washington, and Idaho have all conducted hazardous waste surveys of one form or another. Alaska has planned a similar survey to be conducted in the near future. Agencies in the four states are engaged in siting hazardous waste disposal landfills. To date, only Idaho has succeeded.

CONCLUSIONS

As a result of the study reported herein, many conclusions have been drawn with respect to hazardous waste management in Region X. Some of these are directed to observations about the present status of management. Others are directed to requirements in the future. Specific comments are grouped below to correspond with the order of presentation in the report itself.

The Regional Study Approach

- Inherent in any inventory study of hazardous wastes is the need to derive a precise definition of those wastes. No common approach to this problem has been widely accepted.

- A regional study of this nature is valuable only if it can be taken to a fine level of resolution. When this is achieved, the final product can be expected to give a clear picture of the total hazardous waste management cycle both technically and spatially.

- In the final analysis, the degree of resolution desired for this type of study necessitates the use of direct contact with waste generators, transporters, and processors. The latter cannot be accomplished with form letters, but requires personal interaction with allowance for active feedback.

- State survey efforts are of real value and should be encouraged. If these are conducted in a comprehensive manner, they will form the basis of any regional assessment effort.

- Best survey response is obtained when interviews are preceeded by an analysis of the processes and equipment employed by the industry. This allows the researcher to probe specific areas and touch on subjects which, for one reason or another, may not otherwise come to the surface. Simply asking what a firms hazardous wastes are will be of little value.

Agricultural Wastes

- Based on a good correlation with data for spent pesticide containers in Oregon state and Grant County, Washington, the extrapolation approach taken here is considered a viable one which can produce some meaningful data on the quantity and location of pesticide containers.
- If a similar effort is conducted on a national level or greater detail is desired, an attempt should be made to interpret Frear Codes used in the USDA survey such that results can be categorized by pesticide type, e.g., organophosphate, carbamate, etc.
- Random Surveys of applicators and farmers should be made to complement the data base with information on actual disposal practices.
- A large amount of spent pesticide containers are generated in Region X each year, but data are insufficient to measure the associated environmental impact. There is a real need for suitable means of recycle and reuse of the large number of metal drums disposed of annually.
- States should endorse a standard procedure for decontaminating and disposing of pesticide containers, as well as designate specific sites for receiving residuals.

Industrial Wastes

- Industrial wastes and their sources require the major share of effort and resources in a study of this type.
- Gaps in data with respect to waste constituents, concentrations, and properties preclude application of the Battelle Waste Decision Model to industrial wastes in many cases.
- Nonferrous metals operations, and organic and inorganic chemical manufacturers produce a large volume of potentially hazardous wastes which constitute a major contribution to total hazardous waste volume. Further study is required to clearly define the properties of these specific wastes and hence allow better determination of their hazardous nature.
- Wastes with a particularly high potential for damage to human health or the environment are discharged by electroplating job shops, industries with captive electroplating activities and pesticide manufacturing operations.

- Recycling and reprocessing are an active and vital part of Region X hazardous waste management.

- A study of this nature is valuable for identifying waste sources, but the adequacy of disposal practices cannot be assessed without specific site visits to on-going operations.

- The information presented here becomes dated rapidly. This underscroes the need for a mechanism to require reporting by waste generators. Mandatory reporting will also increase the integrity of the data obtained.

- Approximately 14 percent of the hazardous waste generated in Region X is buried on private land or in public landfills. Some of this activity is indiscriminate and difficult to trace because of the small tank cleaners and haulers involved. Less than one percent of the total waste volume went to the approved hazardous waste disposal site in Owyhee County, Idaho in 1975.

- Large quantities of hazardous wastes are being stored in anticipation of the opening of a new disposal site or some other economic disposal option. When combined with hazardous wastes presently being lagooned, the total constitutes 61 percent of all industrial hazardous wastes identified in this study.

- Effluent analyses indicate that hazardous waste volume may increase as effluent requirements become stricter in 1977 and 1983. This will largely be due to heavy metals present in process waters. This tendency to greater waste volumes will be countered by trends in product substitution, internal recycle, and further waste concentration. The net effect is likely to be growth at a rate commensurate with the growth of the regional economy.

State and Federal Agencies

- Wastes eminating from state and federal agencies include spent pesticide containers and wastes from industrial-like operations at military installations.

- Federal and some state agencies report that they are following EPA guidelines for handling and disposal of spent pesticide containers. States should, however, develop tighter controls for disposal of pesticide containers used by agency personnel.

Public and Private Utilities

- PCB contaminated oils constitute the major hazardous waste generated by utilities.
- Some utilities are not well informed about the disposal options available for these materials.

Waste Processors

- Region X is fortunate to have two firms actively reprocessing and recycling hazardous wastes. Additional strain may be placed on disposal capabilities if Western Processing should fail to solve its present financial and managerial difficulties.
- Waste processors are a second source of hazardous wastes. It cannot be assumed that delivery of wastes to these firms constitutes proper disposition. Indeed, a permit or facility certification process is desirable to both identify all the actors involved and to allow generators to better assess the quality of treatment their residuals will receive.
- "Occasional" drums cause a problem for waste processors. Central collection facilities and transport to disposal sites may be a safer and more cost effective alternative.

Hazardous Waste Management Systems

- At least one more hazardous waste disposal site is needed to serve Region X. The existing Wes Con site is large enough for present demands, but transportation costs from major generation sites are prohibitive.
- A site in Benton, Franklin, Grant, or Adams County, Washington or Sherman or Gilliam County, Oregon, would satisfy many current and future needs.
- Transportation considerations must be a major consideration in site selection as well as local acceptance. The latter is the obstacle to current siting efforts.
- The transportation aspects of hazardous waste management have not been thoroughly studied, they appear to constitute a major weakness in the management cycle from a safety and regulatory standpoint.

- States should be encouraged to develop similar or compatible approaches to regulations, permits, definitions, transportation, and manifests. This will facilitate interstate cooperation and the development of a viable regional waste handling industry.

- State regulatory programs need to consider a wide variety of issues including mandatory reporting, transportation manifests, eminent domain for siting, and disposal site operating permits.

- A waste exchange and information center should be established in Region X to facilitate waste reuse and communications on disposal options. Many small and large waste generators are simply not aware of the options open to them.

II. INTRODUCTION

The need to address the problem of Hazardous Waste Management was recognized in the Resource Recovery Act of 1970. Subsequent efforts led to a series of research studies[1-3] which attempted to identify and quantify hazardous wastes within the United States. All were conducted on a national scale and have been valuable in providing order of magnitude estimates of the national hazardous wastes problem and as aids in formulating national policies on hazardous waste management. Nevertheless, the scale or level of resoultion of these studies is such that their applicability to local, state, and even regional planning for hazardous waste management is limited. Detailed information relating to waste types and quantities, disposal practices, and spacial distribution of sources (all of which is required to accurately assess the status quo of hazardous waste management within a particular geographic area) is not evident in these studies. The collection and evaluation of such detailed information is an essential precursor to meaningful and effective action by federal, regional and state environmental protection agencies.

Recognizing the need for such detailed information, the U. S. Environmental Protection Agency, Region X Office, initiated a study with the following goals:

- Identification and location of hazardous waste being generated in the states of Alaska, Idaho, Oregon, and Washington;
- Estimation of the types and quantities of these wastes;
- Determination of the waste management and disposal practices associated with these wastes;
- Identification of existing and potential hazardous waste disposal sites;

---

[1] Battelle Memorial Institute. "Program for the Management of Hazardous Wastes," Environmental Protection Agency, Contract No. 68-01-0762, July 1973.

[2] Ottinger, R. S., et al. "Recommended Methods of Reduction Neutralization, Recovery, and Disposal of Hazardous Wastes," TRW Systems for Environmental Protection Agency, February 1973.

[3] Booz-Allen Applied Research, Inc. "A Study of Hazardous Waste Materials, Hazardous Effects, and Disposal Methods," Environmental Protection Agency, June 30, 1972.

- Projection of future waste generation patterns;
- Evaluation of current hazardous waste management practices;
- Development of cooperative concepts which could enhance hazardous waste management within the region.

The study was carried out by Battelle-Northwest Laboratories with the valuable assistance of federal, state and municipal offices and the cooperation of literally hundreds of industries within the four state region.

The results of this one year study are presented in the following report. Chapter III describes the approaches, special considerations, definitions, and limits applied to the study. Chapters IV, V, and VI represent the major effort of the study depicting findings relating to hazardous waste generation and management in the agricultural, industrial, and public sectors respectively. Chapter VII deals with those operations within the region which provide special services for hazardous waste disposal, detoxification, and recycling. Finally, in Chapter VIII, the activities of state and federal agencies in the area of hazardous waste management are described. This chapter also explores the needs for future efforts within the region to ensure the continuation and improvement of hazardous waste management practices.

III. APPROACH

CATEGORIZATION OF HAZARDOUS WASTES

Distinction of Regulatory Groupings

The determination of what constitutes a hazardous waste is a difficult and, to date, an unresolved problem. Definitions abound and many times a certain degree of confusion with other regulatory groupings arises. The Federal Water Pollution Control Act Ammendments of 1972 (PL 92-500) defines two groups of materials which are often confused with hazardous wastes: 1) toxic pollutants, and 2) hazardous substances. Toxic pollutants to be designated as a result of Section 307 of that Act are materials considered to threaten sufficient harm to human health or the environment to warrant specific effluent limitations. These are clearly defined as pure compounds and are designated only in the context of discharges to water. Therefore, these materials themselves do not constitute hazardous wastes; however, the sludges produced in removing them from liquid streams may be hazardous wastes. To date, 12 substances have been designated as toxic pollutants:

- Aldrin
- Benzidine
- Cadmium
- Cyanide
- DDD
- DDE
- DDT
- Dieldrin
- Endrin
- PCB's
- Toxaphene

Hazardous substances are defined in Section 311 of PL 92-500 as:

> "...such elements and compounds which, when discharged in any quantity into or upon the navigable waters of the United States or adjoining shorelines or the waters of the contiguous zone, present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, and beaches."

Once again, materials so designated are pure substances and not wastes per se. However, spillage of otherwise designated hazardous wastes may also constitute spillage of hazardous substances based on the pure compounds included in the waste. In other words, hazardous wastes may include hazardous materials as components. Indeed, off-spec or waste batches of hazardous substances also qualify as hazardous wastes. Conversely, recovered materials after spillage of hazardous substances are likely to constitute hazardous wastes. To date, some 350-400 elements and compounds have been proposed for designation as hazardous substances. A complete listing of these can be found in the Federal Register.[4]

A third group of materials which may be confused with hazardous wastes includes toxic substances as defined in pending Toxic Substance legislation. While a final version of this proposed act is not yet available, it would appear that this grouping will include all chemicals and mixtures of commerce which may pose a threat to man or his environment as a result of their distribution, sale, or use. In this context, these materials are products and will become wastes only if discarded.

Figure III-1 is provided to summarize the interrelations of the aformentioned groups as defined by existing and proposed law. Given these distinctions, confusion may still occur as a result of the tendency for people to use the terms toxic and hazardous interchangeably. The words are not synonomous. The former refers to intrinsic characteristics, the latter to extrinsic ones. This distinction has been expressed succinctly by the Food Protection Committee of the National Academy of Sciences:[5]

> Toxicity is the capacity of the substance to produce injury including effects such as teratogenicity, mutagenicity, and carcinogenicity.

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[4] U. S. Environmental Protection Agency. "Designation and Determination of Removability of Hazardous Substances from Water," Federal Register, Vol. 39, No. 164, Part IV, August 22, 1974.

[5] Report of the Food Protection Committee, National Academy of Science, 1970.

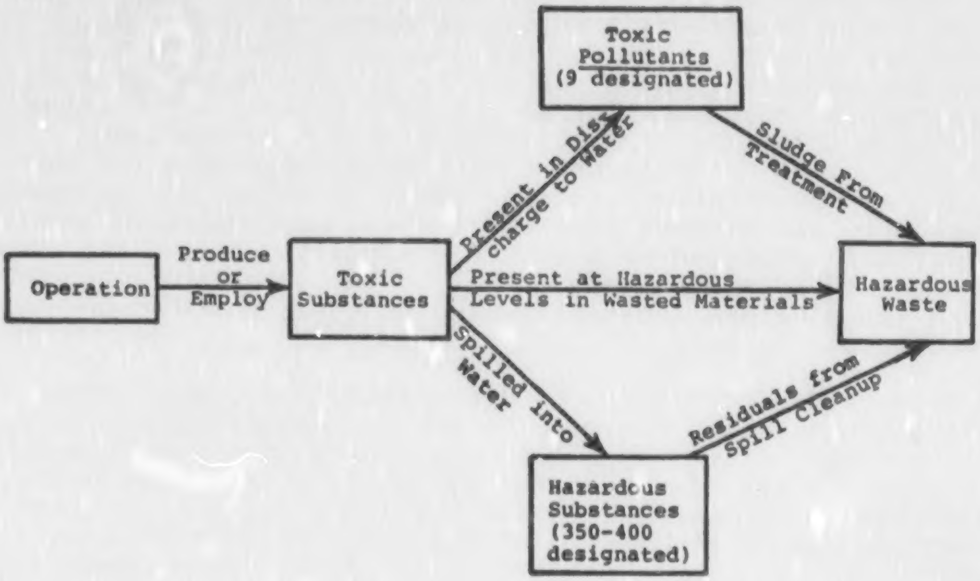
Toxic Pollutants (9 designated)
Present in Discharge to Water
Sludge From Treatment
Operation
Produce or Employ
Toxic Substances
Present at Hazardous Levels in Wasted Materials
Hazardous Waste
Spilled into Water
Residuals from Spill Cleanup
Hazardous Substances (350-400 designated)

FIGURE III-1. RELATION OF VARIOUS HAZARDOUS AND TOXIC MATERIALS DEFINED BY LEGISLATION

> Hazard is the probability that injury will result from use of (or contact with) a substance in a given quantity or manner.

Working Definition of Hazardous Waste

Having segregated hazardous wastes from other material groups created by legislative action, and having clarified the destinction between toxic and hazardous, it is now necessary to establish the specific criteria used in this study to determine whether or not a particular waste is considered hazardous. Typically, hazardous wastes, at the regulatory level, are defined in one of two ways: 1) hazardous wastes are listed, or 2) hazardous wastes are defined by specific, numerical criteria. Both of these approaches offer advantages and disadvantages with the distinction between the two usually occurring between level of resolution and ease of utilization. The former definition (listing) allows relatively easy recognition and classification of wastes once the constituents of the waste are known. It is not necessary to analyze the waste as a new and single entity; rather, the mere presence of a listed or designated hazardous constituent is sufficient for designation of the waste as hazardous. On the other hand, this approach does not consider the possibility of synergistic or antagonistic effects that may be operating in complex wastes nor does it allow for the fact that the hazardous constituents of the waste may not be present in sufficient quantities or concentration to create a hazard. The latter definition (numerical criteria) affords a more flexible approach. Once criteria are established, they need not be changed as new materials arise. Under this type of approach, synergistic and antagonistic effects can be considered since the waste is analyzed as a single entity. Nevertheless, this approach requires more information on the hazardous properties of the waste before a determination of hazardous or non-hazardous can be made.

For this study, both types of definitions were used. This portion represents a decision to take a conservative approach to insure that all potentially hazardous wastes were identified. This approach was also dictated by the fact that most wastes identified in the study were not available for analysis and in many instances the levels of hazardous constituents were unknown. All wastes identified in the study which contained materials listed in the EPA proposed list of non-removable hazardous substances[4] were reported as potentially hazardous wastes. A list of these materials is contained in Appendix A. While this list was generated for a different purpose, the criteria employed were similar to those recommended for use in identifying hazardous wastes.[1] A waste decision model developed by Battelle-Northwest in a previous study[1] was then applied to those identified wastes for which sufficient data for evaluation under this model was available. This model is discussed in detail in Appendix B. Thus, those materials which qualified as hazardous under the waste decision model formed a subset of the potentially hazardous wastes identified through the listing approach. Additionally, some exceptions were made to insure that highly flammable, reactive, bioconcentrative, or genetically active substances not included in the EPA listing[4] were still considered for designation as hazardous. It should be re-emphasized that lacking formally promulgated state or federal regulations and procedures to determine the hazardous or non-hazardous nature of a particular waste, it was not possible to assign the classification of "definitely hazardous" to any of the wastes identified in the study.

A few additional caveats deserve mention. Due to the almost universal utilization of oil lubricants by industrial and commercial operations, this material was not specifically included in the study. This decision was made for reasons of economy and on the basis of preliminary indications that most bulk users were recycling their waste oil. When available, these oil recycling practices were documented for those operations included in the study on the basis of other hazardous wastes.

Hospital and university wastes were also excluded from the study.

In some instances, it is difficult to determine whether or not a particular material is a waste or merely an input to another process. An example of this arose in the case of acetylene production. Those operations which produce acetylene via the carbide process also generate large quantities of calcium hydroxide. Some producers are able to sell this "waste" hydroxide to aluminum plants while others, unable to find a market, are forced to stockpile or dispose of this material. In this situation, a conservative approach was taken. All the potential wastes, even those recycled through secondary markets, were treated as wastes. Current recycling practices were documented in each industry group. Such an approach assured complete coverage and a quantification of potential wastes should secondary markets for these materials decline.

POTENTIAL SOURCES OF HAZARDOUS WASTE

As indicated previously, hazardous wastes may be generated in a variety of ways. The approach used in this study to identify sources of hazardous waste began with a categorization of the general types of activities which had the potential to produce hazardous wastes. These potential sources were initially grouped under three major headings:

- Industrial Operations - which produce a hazardous residual as part of their process or handle hazardous materials, a portion of which is wasted.
- State and Federal Activities - which handle hazardous materials. Also included under this heading are utilities and public utility districts.
- Agricultural Operations - which handle large quantities of pesticides.

This breakdown of potential sources not only facilitated the management and direction of the study, but more importantly, due to the rather unique characteristics of the wastes and the organizations producing the wastes, allowed the use of the most appropriate techniques of ascertaining waste quantities and management practices for each category. For example, determination of waste quantities from centralized state and federal agencies was most easily determined by directly approaching the agencies, while the diverse nature of agricultural pesticide usage required an indirect and less precise approach. Specific survey approaches are discussed more fully in the next section. Before proceeding, brief mention of another potential source of hazardous wastes is in order.

Region X has a number of private companies whose business it is to dispose of and/or process hazardous wastes. These companies are a potential source of hazardous wastes which could arise from reprocessing residuals and improper disposal. The assumption that assignment of hazardous wastes to these companies constituted proper management of the wastes could not be made automatically. Hence, inclusion of these companies was dictated not only by the need to document their role in the management of hazardous wastes, but also to insure that new wastes from a variety of primary sources were not merely being consolidated and passed on to the environment.

Industrial Operations

The survey of industries began with the compilation of a list of industries in the region with the potential to generate hazardous wastes. Industries were selected on the base of their Standard Industrial Classification (SIC)[6]. Appendix C contains a complete listing of the SIC's of industries which, based on their product, were considered as potential hazardous waste generators. This list was selected on the basis of work performed on a national level for EPA.[1] The SIC list contained in Appendix C was then cross referenced with the Manufacturing Directories[7-10] of the states of Alaska, Idaho, Oregon, and Washington. This cross referencing resulted in a list of industries within the four states which due to the nature of their business had the potential to generate hazardous wastes. For the most part, this list proved to be quite comprehensive although some additional waste sources (primarily new operations) were identified during the course of the study as a result of contacts with various federal, state, and local regulatory authorities; industrial representatives; and waste processors.

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[6] U. S. Office of Management and Budget. "Standard Industrial Classification Manual," U. S. GPO, Washington, D. C., 1972.

[7] Alaska Department of Economic Development. "Directory of Alaska Commercial Establishments," Juneau, July 1974.

[8] Idaho Department of Commerce and Development. "Manufacturing Directory of Idaho," Boise, 1973.

[9] Oregon Department of Economic Development. "Directory of Oregon Manufacturers," Salem, 1974.

[10] Washington Department of Commerce and Economic Development. "Directory of Washington Manufacturers," Olympia, 1974.

Agricultural Operations

Virtually all agricultural operations utilize pesticides for vegetation and insect control. These pesticides are handled not only by licensed applicators, but also by individual farmers. A direct survey of individual pesticide disposal practices was beyond the initial scope of the study; however, during the early stages of the program, meetings with state solid waste management representatives from Idaho, Oregon, and Washington revealed a unanimous consensus that spent pesticide containers represented a significant question mark in the area of hazardous waste management and that some quantification of the magnitude of this problem was needed. Subsequent discussions with EPA Regional representatives and the National Office of Solid Waste Management Programs staff resulted in an expansion of the original scope of the study to include a section dealing with agricultural pesticide usage in the Region (excluding Alaska).

The procedure used to estimate regional agricultural pesticide usage and the number of containers resulting from this usage was a statistical one based on data generated during the 1969 Census of Agriculture[11] and the 1971 Farm Production Expenditure Survey[12] conducted by the U. S. Department of Agriculture. The statistical approach is detailed in Chapter IV.

State and Federal Agencies

Hazardous wastes resulting from the activities of various state and federal agencies were identified through direct contact with the individual agencies. The list of state agencies was compiled from previous state solid and hazardous waste surveys[13-15] and individual communications from the Oregon Department of Environmental Quality, Washington Department of Ecology, Idaho Department of Health and Welfare, and Alaska Department of Environmental Conservation. Federal agencies were identified through the Federal Regional Task Force on Hazardous Wastes. Also included under this heading was a direct survey of 157 utilities and public utility districts for the specific purpose of ascertaining waste management practices for polychlorinated biphenyl's (PCB's) found in transformer and capacitor oils.

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[11] Bureau of Census, U. S. Department of Commerce. "1969 Census of Agriculture," Washington, Part 46, Oregon, Part 47, and Idaho, Part 39, Vol, I, Area Reports, Washington, D. C., 1972.

[12] Economic Research Service, U.S. Department of Agriculture. "Farmers' Use of Pesticides in 1971, Quantities, Extent of Crop Use, and Expenditures," Agricultural Economic Report Nos. 252, 268. and 296.

Waste Processing and Disposal Companies

Commercial waste processing and disposal companies were identified through state and federal regulatory agencies. Other activities such as tank cleaning and septic tank companies, which do not process wastes or operate disposal sites, were not identified systematically. Rather, the main source of identification for these types of operation were the industries who were using or had used their services. Because no systematic approach was used to identify these operations and because the industries contacted were not always able to identify these companies by name, coverage of these operations was not complete. This issue is discussed more fully in Chapter VII.

DETERMINATION OF HAZARDOUS WASTE QUANTITIES AND MANAGEMENT PRACTICES

Hazardous waste quantities and management practices by state and federal agencies were determined through direct contact with the individual agencies. The results of this portion of the survey are presented in Chapter VI of this report. Hazardous wastes in the form of spent pesticide containers from the agricultural sector were determined indirectly using the statistical approach described in Chapter IV. This procedure yielded an estimate of total annual pesticide usage by county in the states of Idaho, Oregon, and Washington. From this data, extrapolations to total number of spent pesticide containers were possible; however, the data did not allow detailed determination of waste management practices.

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[13] Idaho Department of Environmental and Community Services. "Idaho Solid Waste Management Industrial Survey Report," June 1973.

[14] Oregon Department of Environmental Quality. "Hazardous Waste Management Planning 1972-73," March 1974.

[15] Washington Department of Ecology. A Report on Industrial and Hazardous Wastes, December 1974.

Hazardous wastes and management practices associated with waste processors and disposal companies are discussed in Chapter VII. Information contained in this chapter was obtained from state and federal regulatory agencies and to a large extent through direct contact with the individual companies.

The survey of industrial sources used a combination of direct and indirect procedures to ascertain hazardous waste types and management practices. As indicated previously, the first step in this procedure was the compilation of a list of industries in the region with the potential to generate hazardous wastes. Given this list of potential industrial hazardous waste generators a number of indirect sources were tapped in order to pare down the list of potential industrial hazardous waste efforts toward those specific industries which showed the highest probability of generating a hazardous waste. To this end, each of the industries identified as a potential generator of hazardous waste was considered individually, using inputs from the following data sources:

- State Manufacturing Directories - Aside from identifying individual firms in a category, these directories typically give brief descriptions of the size of the operation, basic products, and in some instances, the type of process.

- State Surveys - The states of Idaho, Oregon, and Washington had previously conducted industrial solid and hazardous waste studies[13-15] of varying scope and depth in their respective states. Data on Hazardous waste quantities and disposal practices from the Oregon and Washington studies were made available and proved quite helpful to this program. Specific data from the Idaho study could not be released; however, the Idaho Department of Health and Welfare assisted the study team by subdividing the list of potential hazardous waste generators into those known to be hazardous waste generators, those known not to be hazardous waste generators, and those for which they had no information. The state of Alaska had not conducted a survey of industrial hazardous waste generation; however, they were able to comment on the list of industries provided to them by the study team on the basis of their working experience.

- NPDES Permits - The list of potential industrial hazardous waste generators was cross-referenced with the NPDES files maintained at the EPA Regional Office in Seattle. Although the information contained in these files is oriented toward water quality and effluent characteristics, these files proved quite helpful in identifying specific manufacturing and waste treatment procedures used by individual companies. Information contained in field "trip reports" often included discussions of airborne and solid waste management. Data on plant effluent characteristics were also a useful indication of the existance of a hazardous solid waste.

- National Industrial Surveys - Data were extracted from completed and on-going industrial hazardous waste studies sponsored by the EPA Office of Solid Waste Management Programs. These studies proved helpful in two ways: 1) providing general background information on hazardous wastes produced by selected industries, and 2) providing specific information on some of the Pacific Northwest hazardous waste sources where site visits were conducted. Collection of the latter data required direct contact with the individual contractors who conducted the various studies since the final reports submitted to the EPA did not characterize hazardous wastes from individual industrial operations.

- Municipalities - Some of the larger municipalities in the Pacific Northwest maintain industrial effluent monitoring programs. Data collected from these municipalities proved helpful in identifying hazardous effluent constituents and in determining which industrial operations within the municipal jurisdiction were practicing effluent pretreatment.

- Waste Processors - Records maintained by some of the waste processing companies within the region were used to identify and quantify the wastes from a number of industrial sources.

- The Literature - Various reports and publications listed in the reference section of Chapter V were used to provide background material and operating characteristics for various industries.

The data collected from the aforementioned sources allowed the candidate industries to be divided into four basic groups:

1. Known Hazardous Waste Generators

2. Suspected Hazardous Waste Generators

3. Industries for which Little was Known

4. Industries Known not to Generate Hazardous Wastes

At this point it was necessary to shift from an indirect to a direct survey mode in order to realize the level of resolution desired.* The survey was accomplished through direct contact with the industries in order to fill in gaps in the data collected from other sources, verify waste quantities and disposal practices, and survey industries for which no information (other than SIC and products) was available. All firms in Group 1 were contacted. No firms in Group 4 were contacted. Spot contacts with individual firms in Groups 2 and 3 were made. If these indicated hazardous waste generation potential for a SIC Category, all firms in that industrial category were contacted. Industries were approached by phone or letter and asked to provide information relating to:

- Type of Operation
- Number of Employees
- Products and Production Capacity
- Hazardous Wastes Generated
- Hazardous Waste Disposal Practices
- Effluent Characteristics Including Treatment Practices

After the initial telephone or letter contact, a "profile" on the company was prepared. This profile contained a summary of pertinent information derived from the aforementioned sources and the telephone survey. Copies of these profiles were sent to each industry for inspection and comment as to accuracy and completeness. Cooperation by the industries during the initial contact period was excellent. The most common downfall was a failure to respond to the profile. Few firms refused to answer the initial inquiry.

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*Indirect estimates were made where possible as a check against the inherent bias in direct information collection, but the estimates derived in this manner were largely found to be too high because they did not reflect the degree of process modification and recycling being practiced by industry.

IV. HAZARDOUS WASTES FROM THE AGRICULTURAL SECTOR

INTRODUCTION

Spent pesticide containers comprise the major hazardous waste from the agricultural sector. At the same time, they pose one of the most vexing hazardous waste management problems. The disperse nature of their use patterns leads to ubiquitous dissemination rather than collection at discreet sources. Hence, they are somewhat analogous to nonpoint sources of pollution. Further, the user is often untrained and financially constrained from providing proper rinsing and treatment on-site. Consequently, spent containers are often abandoned when emptied or taken to the nearest county landfill for disposal with no precautions taken to prevent leaching of residuals.

In order to design and implement an effective pesticide container treatment program, it is necessary to determine the volume of combustible and noncombustible packages used annually in each county. Unfortunately, there is no good data base at the present time from which such volumes can be estimated. Indeed, during the conduct of the present study, officials in Idaho, Oregon, and Washington confirmed that spent pesticide containers were a major concern to them because they had no feeling for the magnitude involved. This is not uncommon. Similar observations have been made by officials in other agriculturally oriented states such as Minnesota[16] and Florida.[17]

A direct survey of agricultural pesticide usage and disposal practices was beyond the scope of this study; therefore, an indirect estimating procedure was used to ascertain the spatial distribution and intensity of pesticide usage in the states of Idaho, Oregon and Washington. Results of this estimation were then divided into categories based on a previous pesticide container study to indicate the quantities of combustible and noncombustible containers discarded annually in each county.

PESTICIDE USAGE IN REGION X

In order to estimate total pesticide usage in Idaho, Oregon and Washington, it was necessary first to determine typical application rates for various crops in the region. Figures for application rates are not presently published. They differ from year to year, region to region, and among farmers within a region. Consequently, an approximate

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average rate must be selected if final estimates are to be spared distortion from use of a single, potentially anomalous figure. The average rates employed in the work reported here are given by county for each of the three states in Tables IV-1 through IV-3. These estimated rates were derived by the research team as a result of their experience and through use of whatever data could be located.

The average application rates presented in Tables IV-1 through IV-3 were then used to estimate the total tonnage and formulated pesticide desity for each county. The latter was done by taking the product of the application rates and the acreage for each crop as reported in the 1969 Census of Agriculture.[18] Results of these extensions are given in Tables IV-4 through IV-6.

CONTAINER ESTIMATE

Estimates of the number of spent containers generated in each county were made from the tonnage figures given in Tables IV-4 through IV-6. Total pesticide use was first divided between combustible and noncombustible packaging based on a review of common practices by applicators and randomly selected farmers in Region X.

Pesticides in combustible packages were assumed to have been shipped in 50 pound bags. Hence, bag quantity estimates were derived by multiplying county combustible tonnage data by 40. The portion of pesticides purchased in noncombustible packages were assumed to have been delivered in liquid form in containers of various sizes corresponding to the distribution reported by investigators in California.[18] That distribution is detailed in Table IV-7. The fraction of total volume represented by each category in Table IV-7 was used to estimate the volume of materials purchased in each size container in Region X. These estimates of total volume were then divided by container size to yield an estimate of the number of containers. A 1 gallon size was employed for all glass and plastic bottles, since many states, including Washington, do not allow pesticides to be sold to farmers in smaller containers. Contact with a major applicator[20] confirmed that this would be relatively accurate. Some materials such as malathion are sold in small containers, but these are typically for household use. Estimates for liquid pesticides were transformed to volume estimates assuming an average density of 8 pounds per gallon. Container estimates for individual counties in Washington, Oregon and Idaho are shown in Tables IV-8 through IV-10. Table IV-11 summarizes this data by state and container type. Figures IV-1 through IV-3 depict spatial distribution of waste containers in the three states.

TABLE IV-1

ESTIMATED APPLICATION RATES FOR WASHINGTON COUNTIES IN OUNCES OF PESTICIDE (AS FORMULATED) PER ACRE

County	Corn	Alfalfa/ Hay	Vegetables	Berries	Small Grain	Orchards	Wheat	Potatoes	Other Crops
Adams	286	266	588		70	1985	261	8872	306
Asotin		117			237	670	267		670
Benton	749	14	94		224	1985	224	8872	544[c]
Chelan		266				900	115		864
Clallum	272	162	530	271					694
Clark	337		1677	16					653
Columbia		117	94		237	670	268		670
Cowlitz	337	162	1677	16	359		359		653
Douglas		266			115	900	115		864
Ferry		277			185	1651	166		190
Franklin	749	14	94		224	1985	224	8872	544
Garfield		117			237	670	268		670
Grant	286	266	588		70	1985	261	8872	306[b]
Grays Harbor	272	162	530	271					
Island	272	162	530	271					694
Jefferson	272	162	530	271					694
King	388	426	577	2380	426	995		577	1496
Kitsap	272	162	530	271					694
Kittitas	331	14	465		359	1760	359		544
Lewis	337	162	1677	16	359		359		653
Lincoln		277			185	1651	166		190
Mason	272	162	530	271					694
Okanogan						900	115		864
Pacific	272	162	530	271					694
Pend Oreille		277			185	1651	166		190
Pierce	388	426	577	2380	426	995		577	1496
San Juan	272	162	530	271					694
Skagit	388	426	577	2380	426	995		577	1496
Skamania	749	14	94		224	1985	224	8872	544
Snohomish	388	426	577	2380	426	995		577	1496

TABLE IV-1 (Cont'd.)

County	Corn	Alfalfa/ Hay	Vegetables	Berries	Small Grain	Orchards	Wheat	Potatoes	Other Crops
Spokane		277	670		185				670
Stevens		277			185	1651	166		190
Thurston	272	162	530	271					694
Wahkiakum	272	162	530	271					694
Walla Walla	749	14	94		224	1985	224	8872	544
Whatcom	388		577	380	426	995			1496
Whitman		117			237		268		670[a]
Yakima	331		465			1760	359		1620

a - peas and lentils

b - field beans, peas, and sugar beets

c - peppermint, sugar beets, and hops

TABLE IV-2

ESTIMATED APPLICATION RATES FOR OREGON COUNTIES IN OUNCES OF PESTICIDE (AS FORMULATED) PER ACRE

County	Corn	Wheat	Small Grain	Potatoes	Vegetables	Orchards	Hay	Berries	Other Crops
Baker	183	234	248				667		322
Benton	387	287	275		1151	2051	711	1181	958
Clackamus	132	282	254	523	3847	3485	835	1126	640
Clatsop	564	263	234		1376	12522	881	2716	554
Columbia	564	263	234		1376	12522	881	2716	554
Coos						1122	261		1370
Crook		288	342	523			363		617
Curry						1122	261		1370
Deschutes		288	342	523			363		617
Douglas		321	217	6503		1122	261		1880
Gilliam		288	342	523			363		617
Grant	183	234	248				667		322
Harney	250	185	352	502	725	850	415		812
Hood River	564	263	234		1376	12522	881	2716	554
Jackson		321	217	6503		1122	261		1880
Jefferson		288	342	523			363		617
Josephine		321	217	6503		1122	261		1880
Klamath		321	217	6503			261		1880
Lake		321	217	6503			261		1880
Lane	132	282	254	523	3847	3485	835	1126	640
Lincoln	387	287	275		1151	2051	711	1181	958
Linn	132	282	254	523	3847	3485	835	1126	640
Malhevr	250	185	352	502	725	850	415		812
Marion	132	282	254		3847	3485	835	1126	640
Morrow	749	224	224	8872	94	1985	14		544
Multnomah	564	263	234	1376	1376	12522	881	2716	554
Polk	387	287	275		1151	2051	711	1181	958
Sherman		288	342	523			363		617
Tillamook	387	287	275		1151	2051	711	1181	958
Umatilla	749	224	224	8872	94	1985	14		544
Union	183	234	248	502	725	850	667		322

TABLE IV-2 (Cont'd.)

County	Corn	Wheat	Small Grain	Potatoes	Vegetables	Orchards	Hay	Berries	Other Crops
Wallowa	183	234	248				667		322
Wasco		288	342	523			363		617
Washington	564	263	234		1376	12522	881	2716	554
Wheeler		288	342	523			363		617
Yamhill	387	287	275		1151	2051	711	1181	958

TABLE IV-3

ESTIMATED APPLICATION RATES FOR IDAHO COUNTIES IN OUNCES OF PESTICIDE (AS FORMULATED) PER ACRE

County	Wheat	Small Grain	Corn	Hay	Potatoes	Vegetables	Other Crops	Orchards
Ada	264	83	463	449	1606	426	951	850
Adams	264	83	463	449	1606	426	951	850
Bannock	408	358	198	113	300		408	
Bear Lake	551	336	704	800			570	
Benewah	210	156					251	
Bingham	408	358	198	113	300		408	
Blaine	264	83	463	449	1606	426	951	850
Boise	264	83	463	449	1606	426	951	850
Bonner	210	156		117			251	
Bonneville	408	358	198	113	300		408	
Boundary	210	156		117			251	
Butte	188	98					1682	
Camas	264	83	463	449	1606	426	951	850
Canyon	264	83	463	449	1606	1015	951	850
Caribou	551	336	704	800	3021	426	570	
Cassia	255	255	218	675	3021	426	675	
Clark	188	98					1682	
Clearwater	210	156					251	
Custer	188	98					1682	
Elmore	264	83	463	449	1606	426	951	850
Franklin	551	336	704	800	3021	426	570	
Fremont	188	98					1682	
Gem	264	83	463	449	1606	426	951	850
Gooding	375	340	330	675	1444	426	555	
Idaho	210	156		117			251	
Jefferson	188	98					1682	
Jerome	375	340	330	675	1444	426	555	
Kootnai	210	156		117			251	
Latah	210	156		117			251	
Lemhi	188	98					1682	
Lewis	210	156		117			251	

TABLE IV-3 (Cont'd.)

County	Wheat	Small Grain	Corn	Hay	Potatoes	Vegetables	Other Crops	Orchards
Lincoln	375	340	330	675	1444	426	555	
Madison	188	98					1682	
Minidoka	375	340	330	675	1444	426	555	
Nez Perce	210	156		117			251	
Oneida	255	255	218	675	3021	426	675	
Owyhee	264	83	463	449	1606	426	951	850
Payette	264	83	463	449	1606	426	951	850
Power	255	255	218	675	3021	426	675	
Shoshone	210	156					251	
Teton	188	98					1682	
Twin Falls	255	255	218	675	3021	426	675	
Valley	234	248	183	667	1606			
Washington	264	83	463	449	1606	426	951	850

TABLE IV-4

ESTIMATED TOTAL USE OF PESTICIDES IN TONS AS FORMULATED AND COUNTY DENSITY IN TONS PER SQUARE MILE, WASHINGTON, 1969

County	Tons	Metric Tons	Tons/ Mi^2	Metric Tons/ km^2
Adams	5648	5123	2.98	1.04
Asotin	300	272	0.47	0.16
Benton	2803	2542	1.63	0.57
Chelan	741	672	0.25	0.09
Clallum	55	49	0.03	0.01
Clark	370	335	0.59	0.21
Columbia	851	779	1.00	0.35
Cowlitz	57	51	0.05	0.02
Douglas	1230	1115	0.67	0.23
Ferry	115	104	0.05	0.02
Franklin	5213	4728	4.16	1.46
Garfield	853	773	1.20	0.40
Grant	10723	9728	4.00	1.40
Grays Harbor	80	72	0.04	0.01
Island	53	48	0.25	0.09
Jefferson	11	9.9	0.006	<0.01
King	146	132	0.07	0.02
Kitsap	9	8	0.03	0.01
Kittitas	205	185	0.004	<0.01
Klickitat	942	854	0.49	0.17
Lewis	211	191	0.09	0.03
Lincoln	2244	2035	0.97	0.34
Mason	135	122	0.01	<0.01
Okanogan	955	866	0.18	0.06
Pacific	39	35	0.06	0.02
Pend Oreille	157	142	0.11	0.04
Pierce	183	165	0.11	0.04
San Juan	15	13	0.08	0.03

TABLE IV-4 (Cont'd.)

County	Tons	Metric Tons	Tons/ Mi^2	Metric Tons/ km^2
Skagit	937	849	0.54	0.19
Skamania	34	30	0.02	0.01
Snohomish	308	279	0.15	0.05
Spokane	2961	2685	1.68	0.59
Stevens	690	625	0.28	0.10
Thurston	66	59	0.09	0.03
Wahkiakum	21	79	0.08	0.03
Walla Walla	1197	1085	0.95	0.33
Whatcom	593	537	0.28	0.10
Whitman	6996	6345	3.20	1.10
Yakima	5091	4617	1.19	0.42

TABLE IV-5

ESTIMATED TOTAL USE OF PESTICIDES IN TONS AS FORMULATED AND COUNTY DENSITY IN TONS PER SQUARE MILE, OREGON, 1969

County	Tons	Metric Tons	Tons/ Mi^2	Metric Tons/ km^2
Baker	1478	1340	0.48	0.17
Benton	1291	1170	1.93	0.68
Clackamas	1990	1804	1.06	0.37
Clatsop	92	83	0.11	0.04
Columbia	7345	6661	11.48	4.02
Coos	303	274	0.18	0.06
Crook	605	548	2.03	0.71
Curry	24	21	0.01	<0.01
Deschutes	327	296	0.11	0.04
Douglas	401	363	0.08	0.03
Gilliam	1104	1004	0.91	0.32
Grant	1023	927	0.23	0.08
Harney	1621	1470	0.16	0.06
Hood River	5774	5237	11.03	3.86
Jackson	671	608	0.24	0.08
Jefferson	915	829	0.51	0.17
Josephine	153	138	0.09	0.03
Klamath	3529	3200	0.59	0.21
Lake	809	733	0.10	0.04
Lane	3028	2746	0.67	0.23
Lincoln	764	692	0.77	0.27
Linn	4989	4525	2.18	0.76
Malheur	2784	2525	0.28	0.10
Marion	6628	6011	5.69	1.99
Morrow	1270	1151	0.62	0.22
Multnomah	897	813	2.12	0.74
Polk	2255	2045	3.07	1.07
Sherman	1233	1118	1.49	0.52
Tillamook	358	324	0.32	0.11

TABLE IV-5 (Cont'd.)

County	Tons	Metric Tons	Tons/ Mi^2	Metric Tons/ km^2
Umatilla	2520	2285	0.78	0.27
Union	1404	1273	0.69	0.24
Wallowa	904	819	0.28	0.10
Wasco	665	603	0.21	0.07
Washington	7791	7066	10.88	3.81
Wheeler	174	157	0.10	0.04
Yamhill	2339	2121	3.29	1.15

TABLE IV-6

ESTIMATED TOTAL USE OF PESTICIDES IN TONS AS FORMULATED AND COUNTY DENSITY IN TONS PER SQUARE MILE, IDAHO, 1969

County	Tons	Metric Tons	Tons/ Mi^2	Metric Tons/ km^2
Ada	1153	1045	1.11	0.39
Adams	210	190	0.15	0.05
Bannock	1505	1365	1.34	0.47
Bear Lake	1664	1509	1.69	0.59
Benewah	298	270	0.38	0.13
Bingham	2028	1839	0.97	0.34
Blaine	463	419	0.17	0.06
Boise	82	74	0.04	0.01
Bonner	105	95	0.06	0.02
Bonneville	1933	1753	1.05	0.37
Boundary	181	164	0.14	0.05
Butte	2283	2070	8.35	2.92
Camas	834	756	0.79	0.28
Canyon	3868	3508	6.69	2.34
Caribou	2492	2260	1.43	0.50
Cassia	3253	2950	1.28	0.45
Clark	119	107	0.07	0.02
Clearwater	132	119	0.05	0.02
Custer	270	244	0.05	0.02
Elmore	1159	1051	0.38	0.13
Franklin	1589	1441	2.39	0.84
Fremont	1442	1307	0.77	0.21
Gem	523	474	0.94	0.33
Gooding	905	820	1.26	0.44
Idaho	856	776	0.10	0.04
Jefferson	1768	1603	1.61	0.56
Jerome	1865	1697	3.14	1.05
Kootani	1336	1221	1.07	0.36

TABLE IV-6 (Cont'd.)

County	Tons	Metric Tons	Tons/ Mi^2	Metric Tons/ km^2
Latah	1122	1017	1.03	0.36
Lemhi	360	326	0.08	0.03
Lewis	750	680	1.58	0.55
Lincoln	556	504	0.46	0.16
Madison	1735	1573	3.67	1.28
Minidoka	2470	2240	3.29	1.15
Nez Perce	832	754	0.99	0.35
Owyhee	1513	1372	0.20	0.07
Payette	541	490	1.35	0.47
Power	2885	2616	2.04	0.71
Shoshone	6	5	0.0004	<0.01
Teton	448	406	0.98	0.34
Twin Falls	3980	3609	2.04	0.71
Valley	208	188	0.06	0.02
Washington	812	736	0.55	0.19

TABLE IV-7

CONTAINER SIZE DISTRIBUTION IDENTIFIED IN CALIFORNIA[19]

Container	Quantity	Volume Represented (Gallons)	Fraction of Total Volume
55 Gallon Drum	8,000	440,000	.083
30 Gallon Drum	98,000	2,940,000	.557
5 Gallon Pail	346,000	1,730,000	.328
Glass Bottle (1 Gallon)	91,000	91,000	.017
Plastic Bottle (1 Gallon)	81,000	81,000	.015
TOTAL		5,282,000	1.000

TABLE IV-8

ESTIMATED CONTAINERS IN WASHINGTON COUNTIES

	Combustible	Non-Combustible					
		Drums			1 Gallon Bottles		Total
County	50 lb Bags	55 Gallon	30 Gallon	5 Gallon Pail	Glass	Plastic	Non-Combustible
Adams	6,320	2,073	25,473	90,036	23,333	20,588	161,503
Asotin	3,160	83	1,025	3,624	939	829	6,500
Benton	8,920	974	11,971	42,312	10,965	9,675	75,897
Chelan	19,080	100	1,225	4,330	1,122	990	7,767
Clallum	1,880	3	37	131	34	30	235
Clark	7,640	68	831	2,936	761	671	5,267
Columbia	24,360	91	1,123	3,969	1,029	908	7,120
Cowlitz	1,280	9	116	410	106	94	735
Douglas	43,360	55	677	2,394	621	548	4,295
Ferry	3,360	12	144	508	132	116	912
Franklin	11,840	1,857	22,814	80,639	20,897	18,439	144,646
Garfield	7,880	248	3,044	10,758	2,788	2,460	19,298
Grant	20,080	3,860	47,424	167,624	43,439	38,329	300,676
Grays Harbor	2,640	5	65	230	60	53	413
Island	1,600	5	60	213	55	49	382
Jefferson	440						
King	1,040	45	557	1,968	510	450	3,530
Kitsap	320	0(.38)	5	16	4	4	29
Kittitas	2,920	50	612	2,165	561	495	3,883
Klickitat	1,400	343	4,208	14,875	3,855	3,401	22,474
Lewis	4,600	36	445	1,574	408	360	2,823
Lincoln	11,520	739	9,075	32,078	8,313	7,335	57,540
Mason	1,960	32	399	1,410	366	323	2,530
Okanogan	25,200	123	1,508	5,330	1,381	1,219	9,561
Pacific	1,360	2	23	82	21	19	147
Pend Oreille	4,880	13	162	574	149	131	1,029

TABLE IV-8 (Cont'd.)

	Combustible	Non-Combustible					
		Drums			1 Gallon Bottles		
County	50 lb Bags	55 Gallon	30 Gallon	5 Gallon Pail	Glass	Plastic	Non-Combustible
Pierce	1,040	59	728	2,575	667	589	4,618
San Juan	600						
Skagit	7,320	285	3,498	12,366	3,205	2,928	22,182
Skamania	280	10	125	443	115	101	794
Snohomish	2,880	89	1,095	3,870	1,003	885	6,942
Spokane	38,080	759	9,321	32,948	8,538	7,534	66,042
Stevens	18,480	86	1,958	3,739	969	855	6,707
Thurston	2,120	5	60	213	55	49	382
Wahkiakum	840						
Walla Walla	8,840	369	4,528	16,006	4,1 8	3,660	28,711
Whatcom	5,480	172	2,116	7,478	1,938	1,710	13,414
Whitman	57,200	2,102	25,825	91,282	23,656	20,873	163,738
Yakima	56,880	1,386	17,023	60,172	15,593	13,759	107,933
TOTAL	419,080	16,148	198,400	701,278	181,736	160,359	1,260,655

TABLE IV-9

ESTIMATED CONTAINERS IN OREGON COUNTIES

	Combustible	Non-Combustible					
		Drums			1 Gallon Bottles		Total
County	50 lb Bags	55 Gallon	30 Gallon	5 Gallon Pail	Glass	Plastic	Non-Combustible
Baker		558	6,858	24,239	6,282	5,543	43,480
Benton	30,240	202	2,482	8,774	2,275	2,006	15,739
Clackamas	23,760	527	6,477	22,894	5,933	5,235	41,739
Clatsop	2,960	7	84	295	77	68	531
Columbia	180,400	1,071	7,185	46,494	12,049	10,631	77,430
Coos	9,440	25	311	1,099	285	251	1,971
Crook	1,800	211	2,598	9,184	2,380	2,100	16,473
Curry	760	2	23	82	21	19	147
Deschutes	400	120	1,471	5,199	1,347	1,189	9,326
Douglas	4,320	111	1,359	4,805	1,245	1,099	8,619
Gilliam	3,040	388	4,770	16,859	4,369	3,855	30,241
Grant		386	4,747	16,777	4,348	3,836	30,094
Harney	23,240	393	4,825	17,056	4,420	3,900	30,594
Hood River	146,720	795	9,771	34,538	8,951	7,898	61,953
Jackson	12,600	134	1,652	5,838	1,513	1,335	10,472
Jefferson	13,640	217	2,663	9,414	2,440	2,153	16,887
Josephine	840	50	612	2,165	561	495	3,883
Klamath	10,360	1,229	15.126	53,445	13,850	12,220	95,870
Lake	4,440	264	3,239	11,447	2,967	2,618	20,535
Lane	34,920	814	9,999	35,342	9,159	8,081	63,395
Lincoln	10,680	188	2,306	8,151	2,112	1,864	14,621
Linn	56,440	1,351	16,601	58,679	15,207	13,418	105,256
Malheur	32,080	749	9,196	32,505	8,424	7,434	58,308
Marion	72,080	1,823	22,392	79,146	20,511	18,098	141,970
Morrow	200	478	4,869	20,746	5,376	4,744	37,213
Multnomah	20,280	147	1,810	6,396	1,658	1,463	11,474
Polk	31,440	555	6,816	24,092	6,243	5,509	43,215

TABLE IV-9 (Cont'd.)

County	Combustible	Non-Combustible					Non-Combustible
		Drums			1 Gallon Bottles		
	50 lb Bags	55 Gallon	30 Gallon	5 Gallon Pail	Glass	Plastic	
Sherman	3,160	436	5,354	18,926	4,905	4,328	33,949
Tillamook	1,280	123	1,513	5,346	1,386	1,223	9,591
Umatilla	10,960	848	10,421	36,834	9,546	8,423	66,072
Union		530	6,514	23,026	5,267	5,265	41,302
Wallowa		341	4,194	14,826	3,842	3,390	26,593
Wasco	1,160	240	2,951	10,430	2,703	2,385	18,709
Washington	196,960	1,083	13,302	47,019	12,185	10,751	84,340
Wheeler	160	64	789	2,788	700	638	4,979
Yamhill	67,200	249	3,058	10,808	2,801	2,471	19,387
TOTAL	1,007,960	16,715	199,384	725,847	188,086	177,979	1,296,011

TABLE IV-10

ESTIMATED CONTAINERS IN IDAHO COUNTIES

	Combustible	Non-Combustible					Total
		Drums			1 Gallon Bottles		
County	50 lb Bags	55 Gallon	30 Gallon	5 Gallon Pail	Glass	Plastic	Non-Combustible
Ada	9,590	345	4,241	14,990	3,885	3,428	26,889
Adams	2,200	59	719	2,542	659	581	4,560
Bannock	8,280	490	6,022	21,287	5,517	4,868	38,184
Bear Lake	1,200	623	7,651	27,044	7,008	6,184	48,510
Benewah	1,440	99	1,216	4,297	1,114	983	7,709
Bingham	10,880	663	8,148	28,798	7,463	6,585	51,657
Blaine	2,360	115	1,411	4,986	1,292	1,140	8,944
Boise	360	29	353	1,246	323	285	2,236
Bonner	2,680	14	176	623	162	143	1,118
Bonneville	6,600	668	8,203	28,995	7,514	6,630	52,010
Boundary	2,400	46	561	1,984	514	454	3,559
Butte	160	861	10,574	37,376	9,686	8,546	67,043
Camas	2,280	293	3,605	12,743	3,302	2,914	22,857
Canyon	51,400	975	11,985	42,361	10,978	9,686	75,985
Caribou	14,800	801	9,846	34,801	9,019	7,958	62,425
Cassia	71,160	557	6,839	24,174	6,265	5,527	43,362
Clark	2,760	19	232	820	213	188	1,472
Clearwater	1,520	34	418	1,476	383	338	2,649
Custer	8,840	19	227	804	208	184	1,442
Elmore	19,000	258	3,174	11,218	2,907	2,565	20,122
Franklin	3,040	571	7,020	24,813	6,430	5,674	44,508
Fremont	41,760	21	1,847	6,527	1,692	1,493	11,580
Gem	4,020	158	1,939	6,855	1,777	1,568	12,297
Gooding	4,840	2	19	66	17	15	119
Idaho	8,600	242	2,974	10,512	2,724	2,404	18,856
Jefferson	56,080	138	1,698	6,002	1,556	1,373	10,767

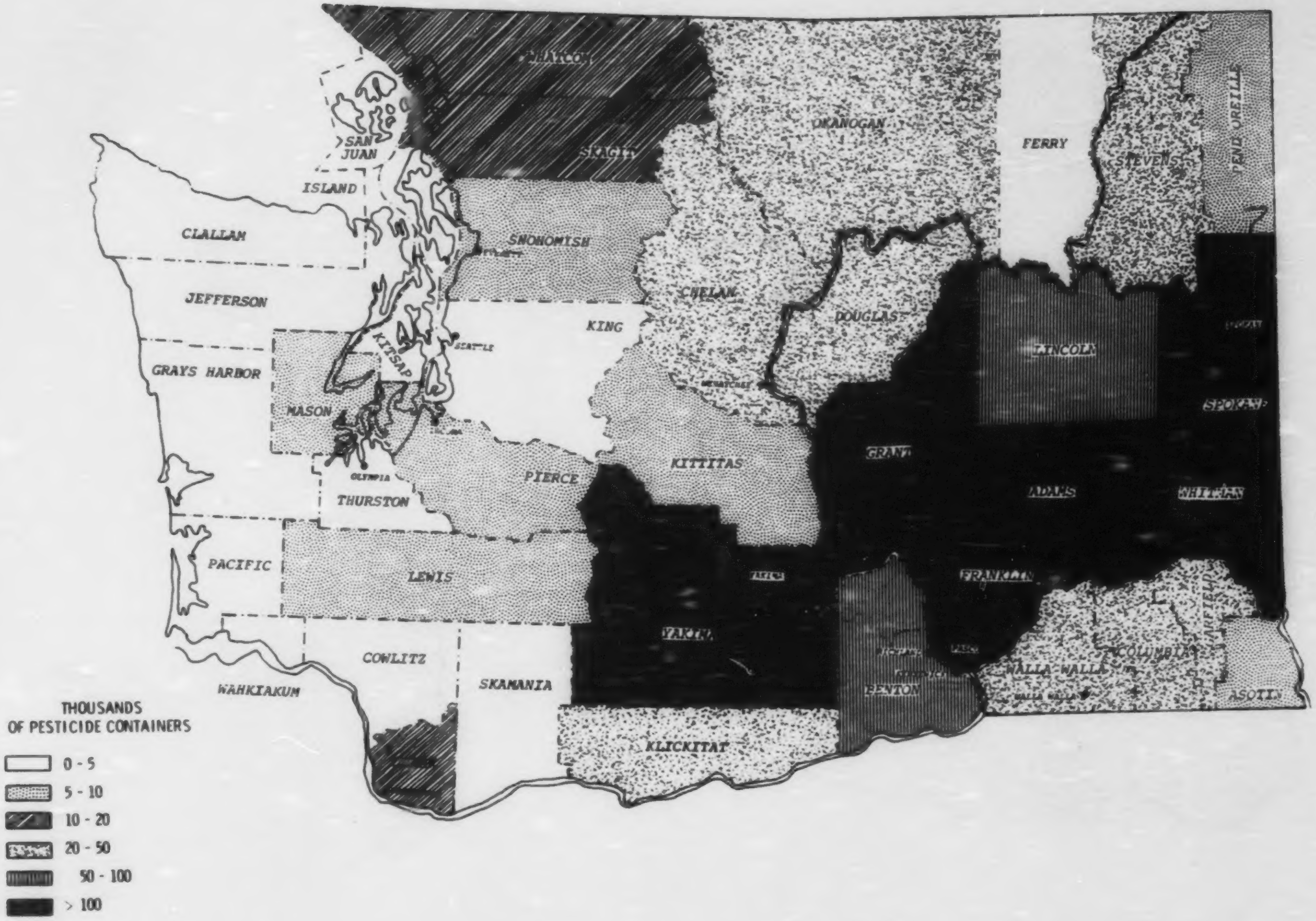
TABLE IV-10 (Cont'd.)

	Combustible	Non-Combustible					
		Drums			1 Gallon Bottles		
County	50 lb Bags	55 Gallon	30 Gallon	5 Gallon Pail	Glass	Plastic	Total Non-Combustible
Jerome	19,800	517	6,357	22,468	5,823	5,138	40,303
Kootnai	11,320	398	4,886	17,269	4,475	3,949	30,977
Latah	8,560	343	4,213	14,891	3,859	3,405	26,711
Lemhi	12,480	18	223	787	204	180	1,412
Lewis	4,880	237	2,914	10,299	2,669	2,355	18,474
Lincoln	4,880	164	2,014	7,118	1,845	1,628	12,769
Madison	51,760	167	2,046	7,232	1,874	1,654	12,973
Minidoka	32,080	630	7,739	27,355	7,089	6,255	49,068
Nez Perce	5,440	260	3,200	11,305	2,930	2,585	20,280
Oneida	1,400	374	4,598	16,252	4,212	3,716	29,152
Owyhee	16,320	417	5,127	18,122	4,696	4,144	32,506
Payette	5,680	151	1,851	6,544	1,696	1,496	11,738
Power	65,320	473	5,809	20,533	5,321	4,695	36,831
Shoshone	200	0(.38)	5	16	4	4	29
Teton	9,680	78	956	3,378	876	773	6,061
Twin Falls	72,960	814	10,003	35,358	9,163	8,085	63,423
Valley	680	72	886	3,132	812	716	5,618
Washington	8,920	222	2,733	9,660	2,503	2,209	17,327
TOTAL	670,610	13,438	166,687	589,168	152,687	134,726	1,056,706

TABLE IV-11

TOTAL CONTAINERS/STATE

	Washington	Oregon	Idaho
50 lb Bags	419,080	1,007,960	670,610
55 Gallon Drums	16,148	16,715	13,438
30 Gallon Drums	198,400	199,384	166,687
5 Gallon Pail	701,278	725,847	589,168
1 Gallon Glass Bottles	181,736	188,086	152,687
1 Gallon Plastic Bottles	160,359	177,979	134,726
Total Non-Combustible	1,260,655	1,296,011	1,056,706
Total Containers	1,679,735	2,303,971	1,727,316



WHATCOM
SAN JUAN
SKAGIT
ISLAND
CLALLAM
JEFFERSON
SNOHOMISH
KITSAP
SEATTLE
KING
GRAYS HARBOR
MASON
OLYMPIA
THURSTON
PIERCE
PACIFIC
LEWIS
WAHKIAKUM
COWLITZ
SKAMANIA
OKANOGAN
FERRY
STEVENS
PEND OREILLE
CHELAN
WENATCHEE
DOUGLAS
KITTITAS
LINCOLN
SPOKANE
SPOKANE
GRANT
ADAMS
WHITMAN
YAKIMA
YAKIMA
FRANKLIN
PASCO
BENTON
WALLA WALLA
COLUMBIA
GARFIELD
ASOTIN
KLICKITAT
THOUSANDS
OF PESTICIDE CONTAINERS
0 - 5
5 - 10
10 - 20
20 - 50
50 - 100
> 100

FIGURE IV-1. DISTRIBUTION OF SPENT PESTICIDE CONTAINERS IN THE STATE OF WASHINGTON

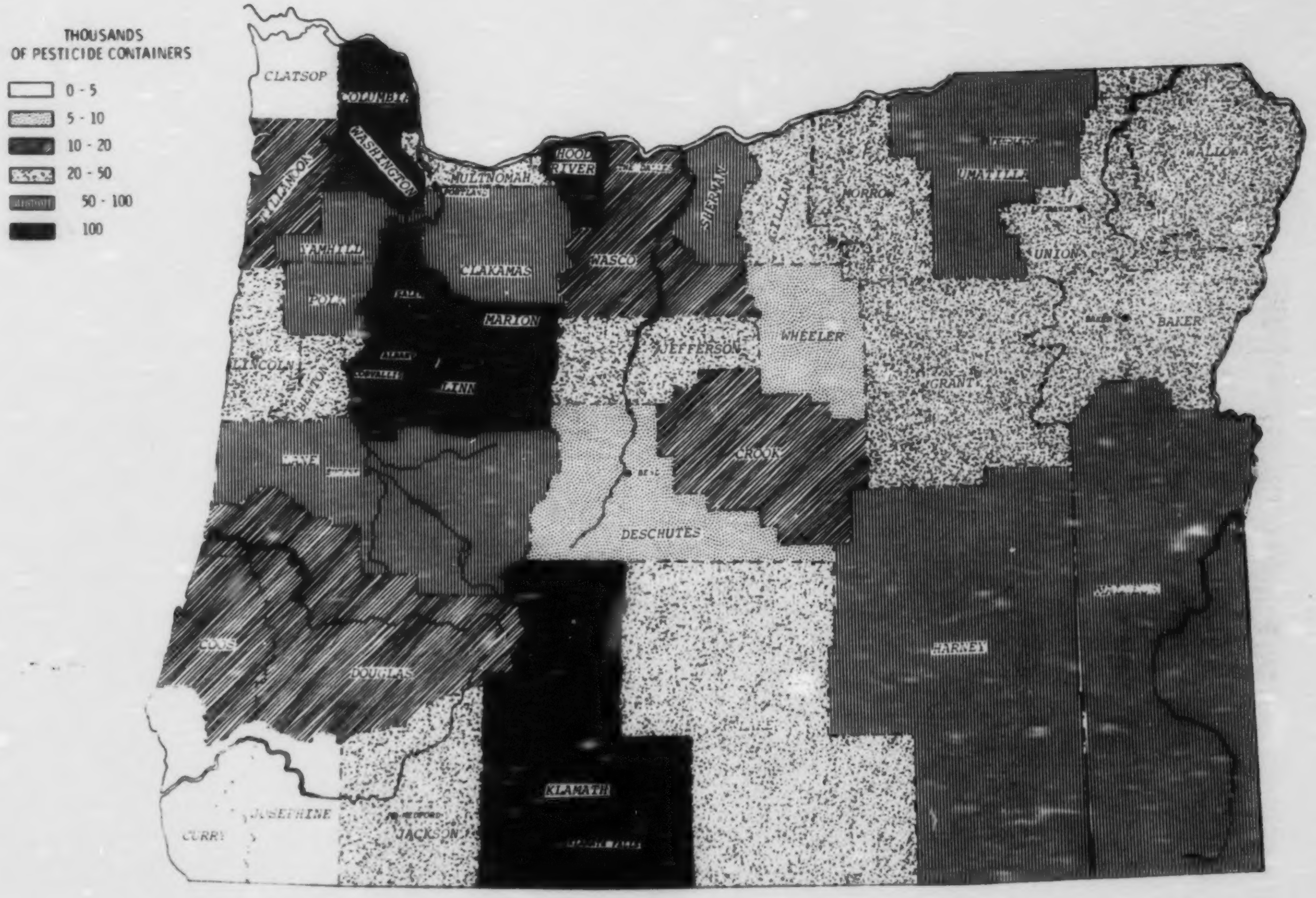

THOUSANDS
OF PESTICIDE CONTAINERS
0 - 5
5 - 10
10 - 20
20 - 50
50 - 100
100
CLATSOP
COLUMBIA
WASHINGTON
TILLAMOOK
MULTNOMAH
HOOD RIVER
SHERMAN
YAMHILL
CLAKAMAS
WASCO
POLK
MARION
LINCOLN
BENTON
LINN
JEFFERSON
WHEELER
CROOK
DESCHUTES
LANE
COOS
DOUGLAS
KLAMATH
JACKSON
JOSEPHINE
CURRY
MORROW
UMATILLA
UNION
BAKER
GRANT
HARNEY

FIGURE IV-2. DISTRIBUTION OF SPENT PESTICIDE CONTAINERS IN THE STATE OF OREGON

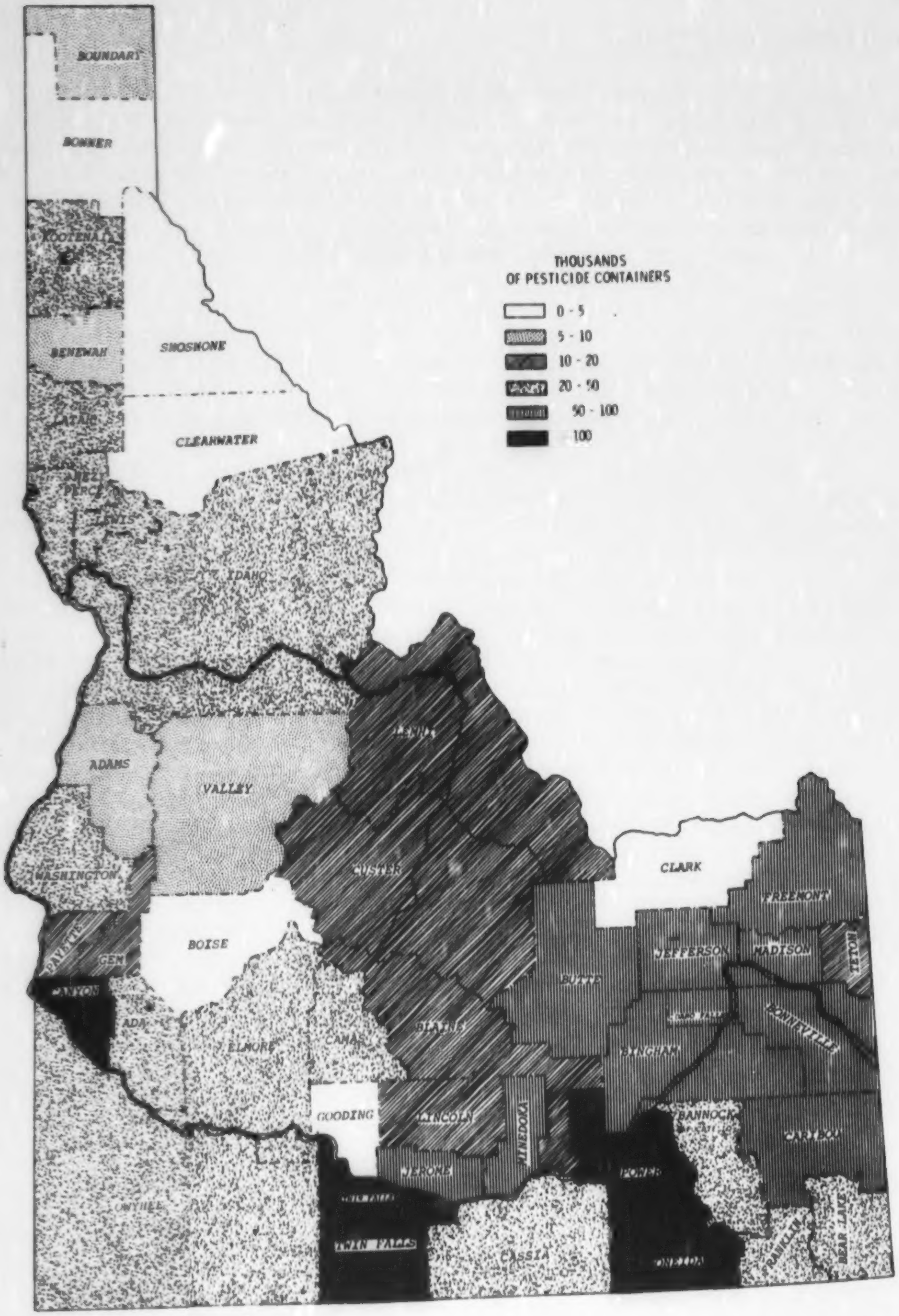

THOUSANDS
OF PESTICIDE CONTAINERS
0 - 5
5 - 10
10 - 20
20 - 50
50 - 100
100
BOUNDARY
BONNER
KOOTENAI
BENEWAH
SHOSHONE
LATAH
CLEARWATER
NEZ PERCE
LEWIS
IDAHO
ADAMS
VALLEY
LEMHI
WASHINGTON
CUSTER
CLARK
FREMONT
JEFFERSON
MADISON
TETON
PAYETTE
GEM
BOISE
BUTTE
CANYON
ADA
ELMORE
CAMAS
BLAINE
BINGHAM
BONNEVILLE
GOODING
LINCOLN
MINIDOKA
BANNOCK
CARIBOU
JEROME
POWER
TWIN FALLS
OWYHEE
CASSIA
ONEIDA
FRANKLIN
BEAR LAKE

FIGURE IV-3. DISTRIBUTION OF SPENT PESTICIDE CONTAINERS IN THE STATE OF IDAHO

DISPOSAL PRACTICES

A direct and quantified determination of pesticide container disposal practices in the agricultural sector was not made. Such an effort was beyond the scope of the study. Although Oregon had no sites approved for pesticide container disposal at the time of the study, a 1973 survey of pesticide applicators by the Oregon Department of Environmental Quality[14] revealed that 63 percent of the spent containers generated by the samples applicators were going to landfill and another 24 percent was being buried on private property. Nine percent were returned to suppliers, 3 percent were sold or reused, and 1 percent was burned. Triple rinsing of noncombustible containers was not the general practice. Subsequent to construction of this report, but prior to its printing, a site has been established near Arlington.

It is expected that similar practices exist in Washington and Idaho. In Washington local health districts have jurisdiction over approval of landfills for pesticide container disposal. Although the DOE is usually consulted or advised of decisions relating to approval/disapproval of applications for pesticide container disposal in local landfills, no specific authority presently exists to grant permits in this area. The Wes Con site near Grandview, Idaho has been approved by the Idaho Department of Health and Welfare for pesticide container disposal. Additionally, the department is presently developing a list of sanitary landfills throughout the state for disposal of triple rinsed containers. However, in both states actual disposal and rinsing practices remain undetermined. In the absence of strong disposal regulations, accompanied by enforcement or economic incentive to recycle metal drums, it can be reasonably assumed that a substantial portion of the spent pesticide containers from the agricultural sector are being randomly dumped in public landfills and on private property throughout the states of Washington and Idaho. This appears to be in contrast with those practices reported by state and Federal agencies which employ pesticides.

V. HAZARDOUS WASTE FROM THE INDUSTRIAL SECTOR

INTRODUCTION

Potentially hazardous wastes from the industrial sector are reported in this chapter. This section represents a major portion of the study which included consideration of approximately 2,500 industrial operations and direct contact with four to five hundred of these industries. This effort resulted in the indentification of 231 industrial sources of potentially hazardous wastes. The basic procedures used to identify sources of potentially hazardous industrial wastes are described in Chapter III.

Findings are reported from three different perspectives in the following sections. Table V-1 reports wastes by industry group, waste type, quantity and management/disposal practices. Also included in the footnotes to this table are qualitative projections of future waste generation patterns as a function of changes in air and water quality standards. Table V-2 presents our regional overview of waste management practices on the basis of eight generic waste types. Table V-3 in conjunction with Figures V-1 thru V-4 depicts the spacial distribution (by counties) of potentially hazardous waste sources in the Region and describes current waste management practices associated with each waste type in each county for which potentially hazardous waste sources were identified.

The concluding section of this chapter discusses available options for the management of wastes identified in the region.

POTENTIALLY HAZARDOUS WASTES BY INDUSTRY GROUPS

Potentially hazardous industrial wastes for the Region are reported in Table V-1 by industrial groups. Industries shown in Column I of this table were grouped on the basis of their primary Standard Industrial Classification (SIC) with the exception of the last group in the table (Miscellaneous Manufacturers). Inclusion of this category was necessary to protect industrial sources in the region with a unique SIC. Reference to reports and other documents describing the waste generation characteristics of various industries are also provided in the column for the interested reader. Column II indicates the number of sources with each industrial group. Where necessary, this number is footnoted to indicate the specific breakdown of industries within the group. In Column III waste types shown in Column IV are grouped into one of eight waste categories as follows:

TABLE V-1

INDUSTRIAL SOURCES OF POTENTIALLY HAZARDOUS WASTES IN REGION X

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons(tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
Wood Treating[1,2,21] (SIC 2491)	22	VI	Pentachlorophenol and creosote contaminated sludge(a)	83.3(b) (91.8)	Stored on company property(c)	See note d
				105.8(b) (116.6)	Waste disposal contractor (destination unknown)	
				17.0(b) (18.7)	Buried on company property	
				30.0(b) (33.1)	Public landfill	
				45.5(b) (50.2)	Unknown(e)	
		VI	Pentachlorophenol and creosote contaminated containers	28 metal drums & 4700 paper sacks	Public landfill	
				100 paper sacks	Buried on company property	
				Unknown quantity (8 operations)	5 companies send containers to public landfill 2 companies send containers to refuse incinerator 1 company is storing the containers on-site	
Newspaper Publishing[1,2]	5(f)	I	Nitric acid etch solution contaminated with zinc(g)	0.5 (0.5)	Dumped to on-property drywell	See note h
		III	Nitric acid etch solution contaminated with magnesium(g)	140.3 (154.7)	Neutralized and dumped to sewer	
		II	Waste solvent and ink	14.3(i) (15.8)	Public landfill via waste disposal company	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons(tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
				12.3(i) (13.5)	Public landfill	
Inorganic[1,2,21-27] Chemicals (SIC 2812, 2819)	6	I	Incinerator residue (0.5-0.8 ppm Hg)	635.0 (700.0)	Buried on company property	See note f
		II	Solvents oils and grease	32.7 (36.0)	Reclaimed	
		IV	Inorganic chemical sludge	90.7 (100.0)	Landfill	
		IV	Fluorides	160.2 (176.6)	Discharge to evaporative holding pond	
		V	Chlorinated hydrocarbons	4.5 (5.0)	Stored on company property	
Organic Chemicals[1,2,21-23,28-31] (SIC 2818, 2821, 286, 2869, 2891, 2892)	18	II	Solvents	1.2(i) (1.4)	Waste disposal company (destination unknown)	See note z
				20.4(i) (22.5)	Stored on company property	
				21.9(i) (23.5)	Used for road oiling	
		V	Creosote and tar saturated earth	31.7 (35.0)	Stored on company property(j)	
		V	Tank washings (complex mixture of organic chemicals)	33.1 (36.5)	Waste disposal company (destination unknown)	
		V	Oxazolodine	463.7 (511.2)	Public landfill (under permit)	
		V	Benzoic acid sludge(g)	22.7 (25.0)	Designated hazardous waste disposal site	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year[metric tons(tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
		V	Thiodiphenol sludge	68.0 (75.0)	Stored on company property	
		V	Catechal sludge	45.4 (50.0)	Future waste (1977) disposition not determined	
		V	Vanallin black liquor solids (1-2% copper)	15,240.7 (16,800.0)	Private landfill	
		V	Vanallin still bottom	299.4 (330.0)	Private landfill	
				299.4 (330.0)	Recycled	
		V	Miscellaneous still bottoms	1.9 (2.1)	Stored on-property	
		V	Phenol contaminated wastewater	22.7 (25.0)	Reclaimed	
		V	Calcium carbonate sludge contaminated with phenol and formaldehyde	850.5 (937.5)	Waste processor	
		V	Phenol-formaldehyde resin wastewater treatment sludge$^{(k)}$	373.7$^{(m,n)}$ (411.9)	Stored on company property$^{(l)}$	
				76.9$^{(m,n)}$ (84.7)	Buried on company property	
				14.7$^{(m,n)}$ (16.2)	Retained in wastewater treatment lagoon	
				113.0 (124.5)	Recycled internally	
		V	Phenol contaminated activated carbon	4.5 (5.0)	Stored on company property	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons(tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
Industrial Gas-Acetylene via Carbide Process[1,2,21,23,24] (SIC 2813)	6	III	Calcium hydroxide (wet lime)(g)	3719.3 (4099.8)	Sold commercially - recycle	See note o
				326.2 (359.6)	Stored in holding pond(p)	
				544.3 (600.0)	Public landfill (under permit)	
Paints and Allied Products[2,21,22] (SIC 2851)	31	II	Solvents and solvent sludges(q)	259.9(i) (286.5)	Reclaimed through waste processor	See note r
				16.8(i) (18.5)	Waste disposal company (destination unknown)	
				30.7(i) (33.8)	Public landfill	
				17.7(i) (19.5)	Stored on company property	
		VII	Pigment bags(s)	260.5(t,u) (287.1)	Public landfill	
		VII	Wastewater treatment sludge (primarily latex washings)	61.8(v,w) (68.1)	Public landfill	
				12.7(w) (14.0)	Waste disposal company (destiantion unknown)	
		VII	Dust from air pollution control equipment	small (<1 MT)	Public landfill	
		VII	Spoiled batches	small (<2 MT)	Public landfill	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons (tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
Pesticide Manufacturing[1,2,21,28,33,34] (SIC 2879)	7(x)	VI	Waste pesticide off-spec pesticides, and pesticide manufacturing waste(g)	645.7(y) (711.8)	Approved hazardous waste disposal site	See note z
		VI	Pesticide containers	20,000 containers	Approved hazardous waste disposal site	
				5,970 containers	Landfill	
				1,040 containers (metal)	Salvage	
		VI	Plastic liners and combustable pesticide containers	0.5 (0.6)	Burned on company property	
Explosives & Munitions[1,2,28] (SIC 2891, 2892, 3482)	6	VIII	Waste explosive or explosive contaminated waste paper(g)	17.7 (19.5)	Controlled burning	See note aa
		VIII	Explosives packaging	18.0 (19.8)	Landfill	
		VIII	Explosives contaminated brass	9.1 (10.0)	Controlled burning - brass recycled	
		III	Sulfuric acid(g)	13,607.7 (15,000.0)	Resold as lower grade acid	
		III	Soda ash	2.7 (3.0)	On-property sump	
		III	Acid and caustic solutions	small quantity (<3.0 MT)	Waste processor	
				0.8 (0.9)	Neutralized and buried on company property	
		II	Solvents	7.9(i) (8.8)	Reclaimed internally through a waste processor	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons(tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
		I	Metal bearing sludge (Pb, Zn, Ni, Cu)	113.6(bb,cc) (125.2)	Storage on-property, no ultimate disposal option selected to date	
Printing Ink Manufacturing[1,2] (SIC 2893)	4	II	Waste solvents	4.2(i) (4.7)	Landfill	See note z
			Solvent and wash-water sludge	3.0 (3.4)	Waste disposal company (destination unknown)	
Petroleum Refining[1,2,21,35,36] (SIC 2911)	6(dd)	V	Heavy hydrocarbon contaminated sludge	62.0 (68.4)	Private landfill	See note ee
				426.0 (469.6)	Land farming	
		V	Acid petroleum sludge	473.2 (521.6)	Road oiling	
		I	Leaded gasoline storage tank bottoms	128.1 (141.2)	Land farming	
		I	"Solutizer" sludge (~ 2% zinc)	1.1 (1.3)	Stored on company property	
		I	Lead contaminated catalyst	50.8 (56.0)	Sent to waste processor for lead recovery	
		IV	Activated aluminium silicate (fluoride contaminated)	130.6 (144.0)	Land farming	
				45.4 (50.0)	Stored on company property	
		IV	"Poly catalyst" (60 % phosphoric acid)(g)	49.0 (54.0)	Land farming	
		V	Phenolic caustic (25% phenol, 5% NaOH)(g)	1017.3 (1121.4)	Sold to petrochemical industry - recycle	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons(tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
Leather Tanning[1,2,37] (SIC 3111)	3	I	Chromic hydroxide sludge	204.1 (225.0)	Public landfill	See note ff
Primary and Secondary Non-Ferrous Metals[1,2,21,38-42] (SIC 333, 334, 335)	16(gg)	IV	Spent potliner (contains cyanide)	28,841.2(nn) (31,792.0)	Stored on-property(ii)	See note jj
		IV	Spent potlining processing residue (contains cyanide)	2,612.7 (2,880.0)	Stored on-property	
		IV	"Black Mud"(kk) (contains cyanide)	27,215.5 (30,000.0)	On-property holding lagoons(ll)	
		IV	Wastewater treatment sludge (primarily calcium fluoride)	12,316.4 (13,576.0)	On-property holding lagoons(mm)	
		IV	Inorganic chemical sludge (calcium fluoride and zirconium oxide)	90.7 (100.0)	On-property holding lagoon(nn)	
		IV	Wastewater treatment sludge (30% zinc)	5,715.3 (6,300.0)	Stored on company property	
		IV	Inorganic chemical sludge (calcium fluoride)	118.1 (130.2)	Public landfill	
		III	Caustic sludge	2.3 (2.5)	Public landfill	
		III	15% Sulfuric acid	762.0 (840.0)	Discharged to holding pond	
		I	Lead and Tin contaminated sludge	0.5 (0.5)	Recycled to lead smelter	
		I	Chromic hydroxide sludge (filter cake)	426.7 (470.4)	Public landfill	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons (tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
Electroplating[1,2,43-45] (SIC 3471)	49	I	Nickel and copper plating bath filter solids	5.4(pp) (5.9)	Public landfill	See note qq
		I	Wastewater treatment sludge (contains heavy metal e.g., Cr, Zn, Cd, Cu, Ni)	156.7(pp) (142.3)	Stored on company property	
				2,293.2(pp) (2,527.8)	Buried on company property	
				75.9(pp) (83.7)	Public landfill	
				2.1(pp) (2.3)	Waste processor	
		I	Exhausted ion-exchange resin	0.1 (0.1)	Waste processor	
		I	Concentrated plating and etching solutions(g)	40.0(b) (44.1)	Waste processor	
				1.9 (2.1)	Stored on company property	
		I	Rinse water	9.1 (10.1)	Stored on company property	
Galvanizing[1,2] (SIC 3479)	4	I	Dross and flux from galvanizing pots (zinc)	5.6 (6.2)	Recycle through smelters	See note z
Electrical and Electronic Products[1,2,43-45] (SIC 35,36)	17	I	Concentrated plating and etching solutions(g)	617.7(b) (680.9)	Waste processor	See note tt
				74.9(b) (82.6)	Water Disposal Company (destination unknown)	
		I	Ion exchange regeneration brine	499.7(b) (550.8)	Storing on company property	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons (tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
		I	Exhausted ion-exchange resin	small quantity (<1.0 MT)	Waste processor	
		I	Waste solder	8.1(ss) (8.9)	Recycled	
		I	Copper and nickel plating bath filter solids	1.7 (1.9)	Public landfill	
		II	Solvents	3.3(i) (3.7)	Reclaimed through waste processor	
				20.4(i) (22.5)	Public landfill	
				2.6(i) (2.8)	Designated hazardous waste disposal site	
		II	Solvent recovery residue	10.0(b) (11.0)	Public landfill	
		III	Caustic sludge (lime)	113.6(bb) (125.2)	Public landfill	
		III	Sulfuric acid	2.6(w) (2.9)	Neutralized and dumped to sewer	
		III	Acid and caustic	26.5(w) (29.2)	Designated hazardous waste disposal site	
		VII	Waste paint and paint sludges	63.6(w) (66.6)	Public landfill	
				64.2(w) (70.7)	Waste disposal company (destination unknown)	
Lead-Acid Batteries[1,2,21,46] (SIC 3691)	11	I	Lead bearing sludge (waste-water treatment)	151.2 (166.6)	Recycled through smelter	See note z
				154.9 (170.8)	Recycled internally	

TABLE V-1 (Cont'd.)

Industry	Number of Operations	Waste Category	Waste Type	Quantity Per Year [metric tons (tons)]	Management/Disposal Practices	Projection Future Waste of Generation Patterns
		I	Dross (lead oxide)	80.6 (88.9)	Recycled internally	
Miscellaneous Manufacturers[1,2,6,7] (SIC 22, 33, 34, 35, 37)(uu)	20	I	Heavy metal sludges	758.1(pp) (835.6)	Waste processor	See note vv
				6.8 (7.5)	Public landfill	
		I	Concentrated heavy metal plating and etching solutions(g)	2,086.1(b) (2,299.5)	Waste processor	
		I	Dillute chromic acid solution	7.6 (8.3)	Dumped to municipal sewer	
		I	Copper and nickel plating bath filter solids	39.6(pp) (43.7)	Reprocessed for metal recovery	
		II	Waste oil and solvents mixture	563.8(i) (621.4)	Waste processor	
				65.1(i) (71.8)	Waste disposal company (destination unknown)	
		II	Waste solvent	58.2(i) (64.2)	Waste processor	
		III	Waste acid(g)	775.0(w) (854.3)	Waste processor	
		III	Waste caustic(g)	1,650.6(bb) (1,819.5)	Waste processor	
		IV	Concentrated cyanide solutions(g)	80.7(b) (88.9)	Waste processor	
		IV	Dillute cyanide solution	0.9 (1.0)	Drumed - sent to public landfill	
		VII	Paint stripping sludge	532.7(w) (587.3)	Waste processor	

NOTES TO TABLE V-1

a. Few of the companies contacted were able to provide direct estimates of sludge volumes. Waste generation factors were derived from these figures and applied to the production levels of seven of the wood treating operations which reported a sludge waste. The waste generation factors used for these estimates are as follows:

1) $\frac{\text{6.3 gal of sludge}}{10^3 \text{ ft}^3 \text{ of treated wood}}$

2) $\frac{\text{125 gal of sludge}}{10^3 \text{ poles treated}}$

The standard deviation for waste generation factor 1) is 3.8 (n=4). Waste generation factor 2) is based on a single data point. The remaining 14 companies reported no significant sludge accumulation to date.

b. Wastes reported in volume units were converted to mass units using a specific gravity of 1.1.

c. Accumulated storage, in addition to annual generation includes 94,635 liters (25,000 gal) of copper arsenate contaminated sludge, 37,854 liters (10,000 gal) of creosote contaminated sludge, and 94,635 liters (25,000 gal) of pentachlorophenol contaminated sludge.

d. Future waste generation patterns for the Region X wood treating industry should remain relatively constant. As inidcated previously, there is reason to believe that some of the PCP and creosote sludges from this industry are not receiving proper disposal. Closer monitoring by state and federal agencies may result in increased usage of waste processing companies by this industry. One wood treating operation indicated that they were using a chemical additive, "Stabilite®" (Reichold Chemical), which has the effect of causing much of the potential waste sludge material to adhere to the pole. Greater use of this material could result in a reduction in sludge volume from this process.

e. The company(s) generating this waste would not indicate their current disposal practices.

f. Survey of this industry was limited to the daily metropolitan newspapers. One of the companies contacted declined to participate in the study.

g. This waste qualifies as hazardous under the Waste Decision Model (Appendix B).

h. The newspaper publishing and printing industry has already undergone a substantial reduction in hazardous waste volume as a result of the shifts to photo offset printing, magnesium printing plates, and water based inks. Comparison of the figures in Table V-1 and those reported in earlier state surveys[14,15] show a substantial reduction in zinc contaminated etching solutions, lead contaminated wastes and to a lesser extent, solvent and ink wastes. Waste levels reported in Table V-1 are expected to remain relatively constant although some additional reduction in the volume of waste solvents may be experienced as the use of water based inks becomes more widespread.

i. Wastes reported in volume units were converted to mass units based on an assumed specific gravity of 0.9.

j. Accumulated storage, in addition to annual generation is estimated to be 90.7 metric tons (100.0 tons).

k. The Oregon Department of Environmental Quality[14] has shown that sludge of this nature, when thoroughly dried, has a very low potential for phenol release.

l. Accumulated storage, in addition to annual generation rate is estimated to be 2,268.0 metric tons (2,500.0 tons).

m. Wastes reported in volume units were converted to mass units based on a specific gravity of 1.5.

n. A waste production factor of 9.9 ft^3 of sludge/10^6 lbs of product was used to estimate quantities for those operations reporting this waste but unable to specify the amount.

o. Lime produced from acetylene manufacturing in the region should remain relativel constant. A report from one of the companies that they were unable to sell all of their product is indicative of the limited demand for this product in the region. Presently an estimated 81 percent of the lime is being sold. The aluminum industry is a major buyer of this product for use in the treatment of scrubber water. Some of the aluminum companies are expected to replace their wet scrubbing systems with dry scrubbing systems some time before 1983. Should this occur, the demand for lime may decline from its present level thus forcing a larger percentage of this marketable material into the waste category.

p. Accumulated storage, in addition ot annual generation is 7,257.5 metric tons (8,000 tons).

q. Twelve of the reporting paint manufacturers were able to quantify solvent wastes. Waste quantities from other operations reporting solvent wastes were estimated using a waste production factor of 10.4 ℓ of waste solvent/10^3 ℓ of oi based paint produced.

r. Potentially hazardous wastes in the form of wastewater treatment sludges may increase as a result of more stringent effluent standards. Effluent management practices for the facilities reported in this study can be characterized as follows:

Practice	Number of Companies
Solids settling with supernatent recycle	1
Landfill or land spreading	3
Recycle to process	9
Septic tank	1
Non-overflowing holding pond	3
Discharge to sewer after pretreatment (floculation/ clarification)	6
Discharge to sewer - no pretreatment*	3 + 3 partial discharge
Unknown*	5

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*Future potential for generation of wastewater treatment sludges.

A slight reduction in solvent waste is expected as a result of the slow trend toward water-based paints[32]. No changes in the quantity of pigment bags are expected although increased pressure to find suitable substitutes for the more toxic pigments may result in a reduced percentage of hazardous constituents.

s. A waste production factor of 23 bags/10^3 liters of paint produced (87 bags/10^3 gal) was used to estimate bag waste for those operations reporting this waste but unable to quantify the amount.

t. Average bag weight = 0.34 kg.[49]

u. Approximately 5.8 percent of the reported bag wastes is contaminated with potentially hazardous pigments.[32]

v. A waste production factor of 5.0 ℓ of sludge/10^3 liters of paint produced was used to estimate sludge volume for those operations reporting this waste but unable to quantify the amount.

w. Wastes reported in volume units were converted to mass units using an assumed specific gravity of 1.4.

x. This group includes two pesticide manufacturers and five of the larger pesticide formulators in the region. It is likely that there are other formulators in the region in addition to those reported herein. Routine wastes from the formulation operations are in the form of empty containers. Occasional wastes include excess or otherwise unusable pesticides.

y. Not reported in the annual generation rate is the 25,000 55 gallon drums of 2-4-D and MCP pesticide manufacturing waste and 100 tons of metalic chloride wastes existing at the Alkali-Lake Disposal Site in Lake County, Oregon.[14]

z. No significant changes in the waste generation patterns of this industry are anticipated.

aa. Data for the explosives industry may be incomplete. The single source for identification of operations in the U. S. is the Internal Revenue Service which considers locations of plants as confidential. Hence, some firms may not have been identified. Indeed, one of the explosives manufacturers identified had an unlisted phone number and did not respond to a letter inquiry.

Solid waste from the explosives manufacturing industry may increase as tighter air pollution controls are instituted. Similar increases from the munitions manufacturers may be expected with tighter effluent limitations.

bb. Wastes reported in volume units were converted to mass units using an assumed specific gravity of 1.2.

cc. The figure represents an estimated volume of a wastewater treatment sludge expected to come on line in January 1976.

dd. This group includes four crude oil refineries and two oil re-refining operations.

ee. No significant charges in solid wastes as a result of tighter air and water pollution control standards are anticipated for this industrial group.

ff. Future solid hazardous waste generation patterns for the leather tanning industry in Region X should remain relatively constant or decline. The largest of the three tanneries indicated that they were considering a shift to closed loop operation which would include recovery and recycle of the present chromium waste. Depending on the process chosen to achieve this goal, hazardous waste volumes from this operation may well decline.

gg. The 15 plants under this general heading include the following:

- Seven primary aluminum plants (SIC 3334)
- One aluminum alloying plant (SIC 3334)
- One tin and steel reclaimer (SIC 3341)
- Two secondary lead and zinc smelters (SIC 3356)
- One copper smelter (SIC 3331)
- One primary lead and zinc smelter (SIC 3333)
- One primary producer of exotic metals (SIC 3339)

hh. A waste production factor of 53.0 kg of spent potliner per metric ton of aluminum produced[48] was used to estimate the quantity of this waste from aluminum plants otherwise unable to estimate thier annual waste production rate.

ii. An estimate 117.0 to 136.1 thousand metric tons (130 to 150 thousand tons) of this reclaimable waste is presently being stored by a number of the aluminum companies in Region X.

jj. Potentially hazardous solid wastes from the aluminum industry in Region X are expected to diminish. Two of the aluminum plants in Region X have shifted to dry scrubbing systems. Two other plants in the region inidcated plans to shift to this type of system which affords close to 100 percent recycle of fluoride. The fluorides when removed by wet scrubbing systems often produce a calcium fluoride sludge. A similar reduction in the volume of spent potliner is expected as a result of technological advances relating to improved physical properties of the carbon potliners. National projections[48] show an increase in the quantities of land disposed sludges from air and water pollution control in the non-ferrous metals industry. This study concurs with this projection (with the exception of aluminum reduction as noted above); however, their magnitude in Region X should be less since a number of the non-ferrous metal plants in the Region have already installed air and water pollution control equipment as witnessed by the residual sludges reported in Table V-1.

kk. This waste from a primary aluminum plant is a composite of scrubber tower sludge, spent potlining residue, and spent lime. Potentially hazardous constituents include calcium fluoride and cyandies (both free and complexed).

ll. Accumulated storage of this waste, in addition to annual production is estimated to be 136.1 to 181.4 thousand metric tons (150 to 200 thousand tons).

mm. Accumulated storage, in addition to annual production is estimated to be 113.4 to 136.1 thousand metric tons (125 to 150 thousand tons).

nn. Accumulated storage, in addition to annual production is estimated to be 272.6 to 453.6 metric tons (300 to 500 tons).

oo. Accumulated storage, in addition to annual production is estimated to be 7,257.5 to 1,0886.2 metric tons (8,000 to 12,000 tons).

pp. Wastes reported in volume units were converted to mass units using an assumed specific gravity of 2.0.

qq. Potentially hazardous solid wastes from the electroplating industry are expected to increase. Only six of the operations identified in the study had pretreatment to remove heavy metals from their effluent. Five operations accomplished this through precipitation (lime addition) and one through reverse osmosis. Water conservation practices such as counter current and over-the tank rinsing were identified in all operations contacted. Such conditions indicate that the limits of internal wastewater volume reduction are being approached and that tighter effluent limitations may well dictate the installation of industrial wastewater pretreatment by many of the electroplaters.

rr. Industries categorized under this grouping include:

- Printing Press Machinery (SIC 3555)
- Automatic Control Equipment (SIC 3679)
- Printed Electronic Circuit Boards (SIC 3679)
- Computer Peripherals (SIC 3573)
- Electronic Components (SIC 3629)
- Lighting Equipment (SIC 3649)
- Electromechanical Assemblies (SIC 3629)

ss. Wastes reported in volume units were converted to mass units using a specific gravity of 8.9.

tt. Future waste generation patterns for this industrial group are difficult to predict. Eight of the industries with known industrial discharges had no wastewater treatment. One of these is planning installation of a treatment plant for heavy metals removal. Similar moves by the remaining seven may be necessary to meet tighter effluent standards. Such installations may result in moderate volumes of metal bearing sludges and brines requiring special disposal.

uu. Industries covered under this heading include the following:

- Mirror Manfuacturing (SIC 3231)
- Steel pipe and tube manufacturing (SIC 3317)
- Copper drawing, rolling, and extrusion (SIC 3351)
- Aluminum rolling and drawing NEC (SIC 3355)
- Aluminum foundries (SIC 3361)
- Metal heat treating (SIC 3398)
- Cutlery, hand tools, and general hardware manufacturing (SIC 342)
- Heating equipment (SIC 3433)
- Fabricated plate work (SIC 3443)

- Construction machinery and equipment (SIC 3531)
- Aircraft and parts (SIC 372)
- Knitted outerware (SIC 2253)

vv. Future waste generation patterns in this diverse group are difficult to predict. Ten of the 21 operations surveyed showed effluent concentrations of toxic metals (Cd, Cr, Zn, Cu) in the 1-10 ppm range. Four of these facilities have installed treatment equipment to remove these materials. More stringent effluent standards may dictate the installation of similar or more extensive equipment at the other facilities. Such a move would most likely increase the volume of metal bearing sludge requiring disposal.

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[37] Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Leather Tanning and Finishing Point Soruce Category, EPA-440/1-74-016-a, March 1974.

[38] Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Secondary Aluminum Smelting Subcategory of the Aluminum Segment of the Non-Ferrous Metals Manufacturing Point Source Category, EPA-440/1-74-019-e, March 1974.

[39] Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Copper, Nickel, Chromium and Zinc Segment of the Electroplating Point Source Category, EPA-440/1-74-003-a, March 1974.

[40] Development Docuemnt for Effluent Limitations Guidelines and New Source Performance Standards for the Primary Aluminum Smelting Segment of the Non-Ferrous Metals Manufacturing Point Source Category, EPA-440/1-74-019-d, March 1974.

[41] Sittig, M. Pollution Removal Handbook, Noyes Data Corporation, Park Ridge, New Jersey, 1973.

[42] Charles River Associates. "The Effects of Pollution Control on the Non-Ferrous Metals Industry," for Council on Environmental Quality, December 1971.

[43] Martin, J. J. "Chemical Treatment of Plating Waste for Removal of Heavy Metals," Environmental Protection Technology Series, EPA-R2-73-044, May 1973.

[44] Battelle Memorial Institute Columbus Laboratories. "A State of the Art Review of Metal Finishing Waste Treatment," Water Pollution Control Research Series 12010 ElE, November 1968.

[45] "Assessment of Industrial Waste Practices -- Electroplating and Metal Finishing Industry," Executive Summary, Draft Final Report, EPA, June 1975.

[46] Versar, Inc. "Assessment of Industrial Hazardous Waste Practices, Storage and Primary Batteries Industries," Final Report, EPA Contract No. 68-01-2276.

[47] Berkowitz, J. B., G. R. Schimic, and V. R. Valeri. "Water Pollution Potential of Manufactured Products Catalog Section III Chemical Ingredient Listing," Environmental Protection Technology Series, EPA R2-73-179, April 1973.

Category I -- Heavy metal solutions and sludges

Category II -- Organic solvents and oils

Category III -- Caustic and acid solutions

Category IV -- Inorganic chemical solutions and sludges

Category V -- Organic chemical solutions and sludges

Category VI -- Pesticide wastes

Category VII -- Paint wastes

Category VIII -- Explosive wastes

These waste categories are used in the regional summary (Table V-2) and for purposes of depicting the spacial distribution of wastes (Table V-3).

Columns IV and V depict waste types and quantities generated per year respectively. This information was derived through a combination of direct and indirect methods as described in Chapter III. Amplifying footnotes are provided to indicate the specific estimation and commission procedures used to derive the figure shown in Column V. Those wastes which qualify as hazardous under the Waste Decision Model (Appendix B) are so indicated by footnote. Column VI reports current management and/or disposal practices for the wastes shown in Column V. Estimates of total accumulated storage for those operations using this option are reported in the footnotes under this column. Footnotes in Column VII present a qualitative estimate of future waste generation patterns for each of the industrial groups shown in the table.

REGIONAL SUMMARY OF WASTE MANAGEMENT PRACTICES

Waste management practices for the eight industrial waste categories described in the previous sections are shown for the entire region in Table V-2.

GEOGRAPHICAL DISTRIBUTION OF POTENTIALLY HAZARDOUS WASTES

Table V-3 in conjunction with Figures V-1 thru V-4 depict the geographical distribution of potentially hazardous wastes from industrial sources on a county basis. The shaded areas

TABLE V-2

REGIONAL SUMMARY OF POTENTIALLY HAZARDOUS INDUSTRIAL WASTE AND MANAGEMENT PRACTICES

Waste Type	Waste Processor	Landfill	Discharge To Sewer	Buried On Property	Recycled Or Sold As Product	Waste Disposal Company*	Stored On Property	Septic Or Holding Tank
I. Metal Sludges and Solutions	3,555.9	720.6	7.6	2,928.2	440.5	74.9	782.1	0.5
II. Solvents and Oils	885.2	91.9			40.6	86.1	38.1	
III. Caustics and Acids	2,428.6	660.2	142.9	0.8	17,327.0			2.7
IV. Inorganic Chemicals	80.7	209.7					37,214.6	
V. Organic Chemicals	850.5	16,065.8		76.9	1,452.4	33.1	484.3	
VI. Pesticide Wastes		30.0		17.0		105.8	83.3	
VII. Paint Wastes	532.7	335.7				76.9		
VIII. Explosives		18.0						
TOTAL (METRIC TONS)	8,333.6	18,181.9	150.5	3,022.9	19,260.5	76.9	38,602.4	3.2
TOTAL (TONS)	9,186.2	20,042.1	165.9	3,332.2	21,231.1	415.5	42,551.9	3.5

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*Ultimate destination of waste unknown.

TABLE V-2 (Cont'd.)

Waste Type	Secured Landfill	Road Oiling	Burning	Storage Lagoon Or Holding Pond	Land Farming	Unknown	Total [metric tons (tons)]
I. Metal Sludges and Solutions					128.1		8,638.4 (9,522.2)
II. Solvents and Oils	2.6	21.9					1,166.4 (1,285.7)
III. Caustics and Acids	26.5			1,088.2			21,676.9 (23,894.7)
IV. Inorganic Chemicals				39,782.8	179.6		77,467.4 (85,393.2)
V. Organic Chemicals	22.7	473.2		14.7	426.0	45.5	19,945.1 (21,995.7)
VI. Pesticide Wastes	645.7		0.5			45.5	927.8 (1,022.7)
VII. Paint Wastes							995.3 (1,097.1)
VIII. Explosives			26.8				44.8 (49.4)
TOTAL (METRIC TONS)	697.5	495.1	27.3	40,885.7	733.7	91.0	130,862.1
TOTAL (TONS)	768.9	545.3	30.1	45,068.8	808.8	100.3	144,250.1

TABLE V-3

GEOGRAPHIC DISTRIBUTION OF POTENTIALLY HAZARDOUS INDUSTRIAL WASTE

WASTE CATEGORY

WASHINGTON

County or District (Total Metric Tons)	Category I	Category II	Category III	Category IV	Category V	Category VI	Category VII	Category VIII
Benton (160.7)	SP: 0.5			LG: 160.2				
Chelan (9,259.4)				ST: 6,350.3 LG: 2,791.0 LF: 118.1				
Clark (3,064.7)	RC: 0.7	WD: 0.7 ST: 20.4		ST: 2,880.1	WD: 30.3 ST: 69.9	WD: 58.3	LF: 4.3	
Cowlitz (27,244.4)		LF: 1.8		LG: 27,215.5	SL: 22.7	LF: 4.4		
King (24,391.9)	WP: 3,216.7 RC: 1.9 ST: 144.1 LF: 0.4	WP: 650.7 WD: 18.7 LF: 4.7 RC: 6.8	WP: 1,607.9 RC: 1,284.6 SW: 108.9 LG: 762.0 LF: 2.3	WP: 73.3 LF: 1.0	RC: 299.4 LF: 15,540.1 BP: 34.4	WD: 5.2 ST: 22.9	WP: 532.7 LF: 72.6 WD: 0.6	
Klickitat (12,110.9)				LG: 4,762.7 ST: 7,348.2				
Pierce (13,942.2)	RC: 0.5 BP: 0.1 LF: 0.1	RC: 32.7 WP: 13.1 LF: 14.3	RC: 13,607.8 SP: 2.7	LF: 90.7	LF: 66.6 BP: 42.5	UK: 26.8	LF:30.0	BU: 17.7
Skagit (1,731.2)	FL: 64.6 SP: 1.1	WP: 65.3		LF: 179.6	RC: 1,017.3 FL: 403.3			
Snohomish (74.2)	WP: 0.1 LF: 9.2		SW: 42.0			ST: 22.9		
Spokane (1,935.1)	LF: 428.5 RC: 104.1	LF: 11.1	RC: 1,291.6			LF: 30.0 BU: 0.5	LF: 69.3	
Whatcom (12,208.7)	BP: 635.0 FL: 63.5 WP: 50.8	WP: 29.4 WD: 15.7		ST: 11,377.9	FL: 22.7	ST: 12.5 LF: 1.2		
Yakima (10.9)						LF: 10.9		

TABLE V-3 (Cont'd.)

OREGON

County or District (Total Metric Tons)	Category I	Category II	Category III	Category IV	Category V	Category VI	Category VII	Category VIII
Clackamas (99.3)	RC: 37.1 SW: 7.6 SL: 6.9	WD:47.7						
Deschutes (1.1)	BP: 1.1							
Jackson (416.3)	WD: 75.0		ST: 326.6		LG: 14.7			
Josephine (66.2)			SW: 2.6				WD: 63.6	
Lane (492.2)	RC: 1.0 LF: 1.4 ST: 0.7	WD: 1.4			LG: 322.7 RC: 113.0	ST: 25.0 WD: 17.3	LF: 9.7	
Linn (95.2)	LF: 4.5			LG: 90.7				
Marion (480.7)	RC: 330.4	WP: 40.9 LF: 20.4					LF: 89.0	
Multnomah (4,386.7)	RC: 64.4 LF: 83.5 BP: 4.3 WP: 2.1 ST: 9.1	WP: 49.0 LF: 19.3 ST: 17.7 RO: 21.3	RC: 1,143.1 WP: 817.6		WP: 873.2 ST: 31.7 WD: 1.9 RO: 473.2	SL: 645.7 WD: 25.0	LF: 92.9 WD: 12.7	
Union (51.0)					ST: 51.0			
Wasco (8.572.9)				LG: 4.762.7 ST: 3,810.2				
Washington (2,497.3)	RC: 1.9 BP: 2,292.6 LF: 192.8	WP: 8.5					LF: 1.5	
Yamhill (499.7)	ST: 499.7							

TABLE V-3 (Cont'd.)

IDAHO

County or District (Total Metric Tons)	Category I	Category II	Category III	Category IV	Category V	Category VI	Category VII	Category VII
Ada (35.3)	LF: 0.3	SL: 2.6	SL: 26.5				LF: 5.9	
Bannock (134.1)	LF: 0.1	LF: 20.4	LF: 113.6					
Bonner (35.8)						BP: 17.1 UK: 18.7		
Nez Perce (140.7)	UK: 113.6							BU: 9.1 LF: 18.0
Shoshone (5,715.3)	ST: 5,715.3							

ALASKA

County or District (Total Metric Tons)	Category I	Category II	Category III	Category IV	Category V	Category VI	Category VII	Category VII
Anchorage District (1,008.6)	RC: 0.6		LF: 544.3		LF: 463.7			

KEY:

BP = Buried On-Property
BU = Burned
FL = Land Farming
LF = Public Landfill
LG = Lagoon or Holding Pond
RO = Road Oiling
RC = Recycled or Sold

SL = Secured Landfill
SP = Septic Tank
ST = Storage On-Property
SW = Neutralized and Dumped to Sewer
UK = Waste Disposal Practice Not Indicated
WD = Waste Disposal Company (Ultimate Disposition Unknown)
WP = Waste Processor

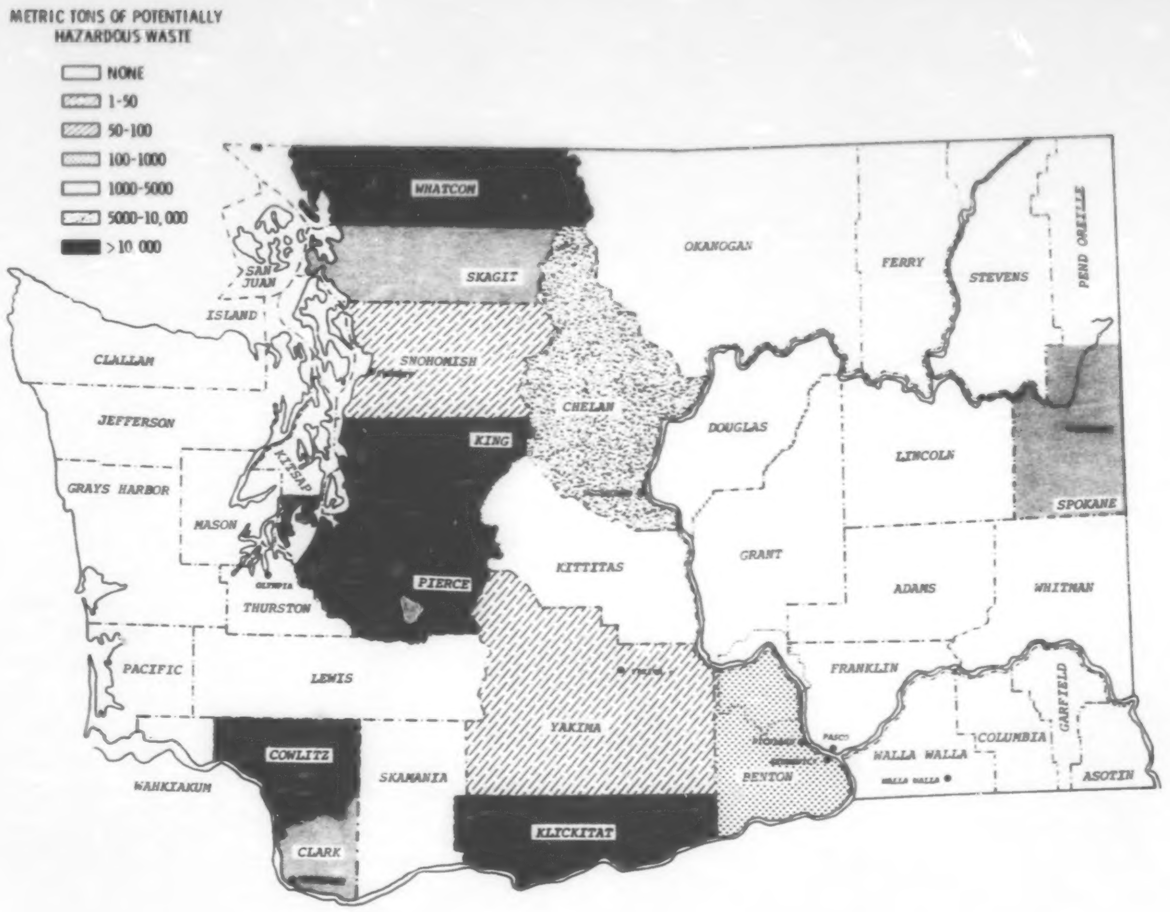
METRIC TONS OF POTENTIALLY HAZARDOUS WASTE
NONE
1-50
50-100
100-1000
1000-5000
5000-10,000
>10,000
WHATCOM
SKAGIT
SAN JUAN
ISLAND
CLALLAM
JEFFERSON
SNOHOMISH
KITSAP
KING
GRAYS HARBOR
MASON
PIERCE
OLYMPIA
THURSTON
PACIFIC
LEWIS
WAHKIAKUM
COWLITZ
CLARK
SKAMANIA
KLICKITAT
YAKIMA
KITTITAS
CHELAN
OKANOGAN
DOUGLAS
GRANT
FERRY
STEVENS
PEND OREILLE
LINCOLN
SPOKANE
ADAMS
WHITMAN
FRANKLIN
PASCO
BENTON
WALLA WALLA
COLUMBIA
GARFIELD
ASOTIN

FIGURE V-1. LOCATION OF POTENTIALLY HAZARDOUS INDUSTRIAL WASTE GENERATING ACTIVITIES IN THE STATE OF WASHINGTON

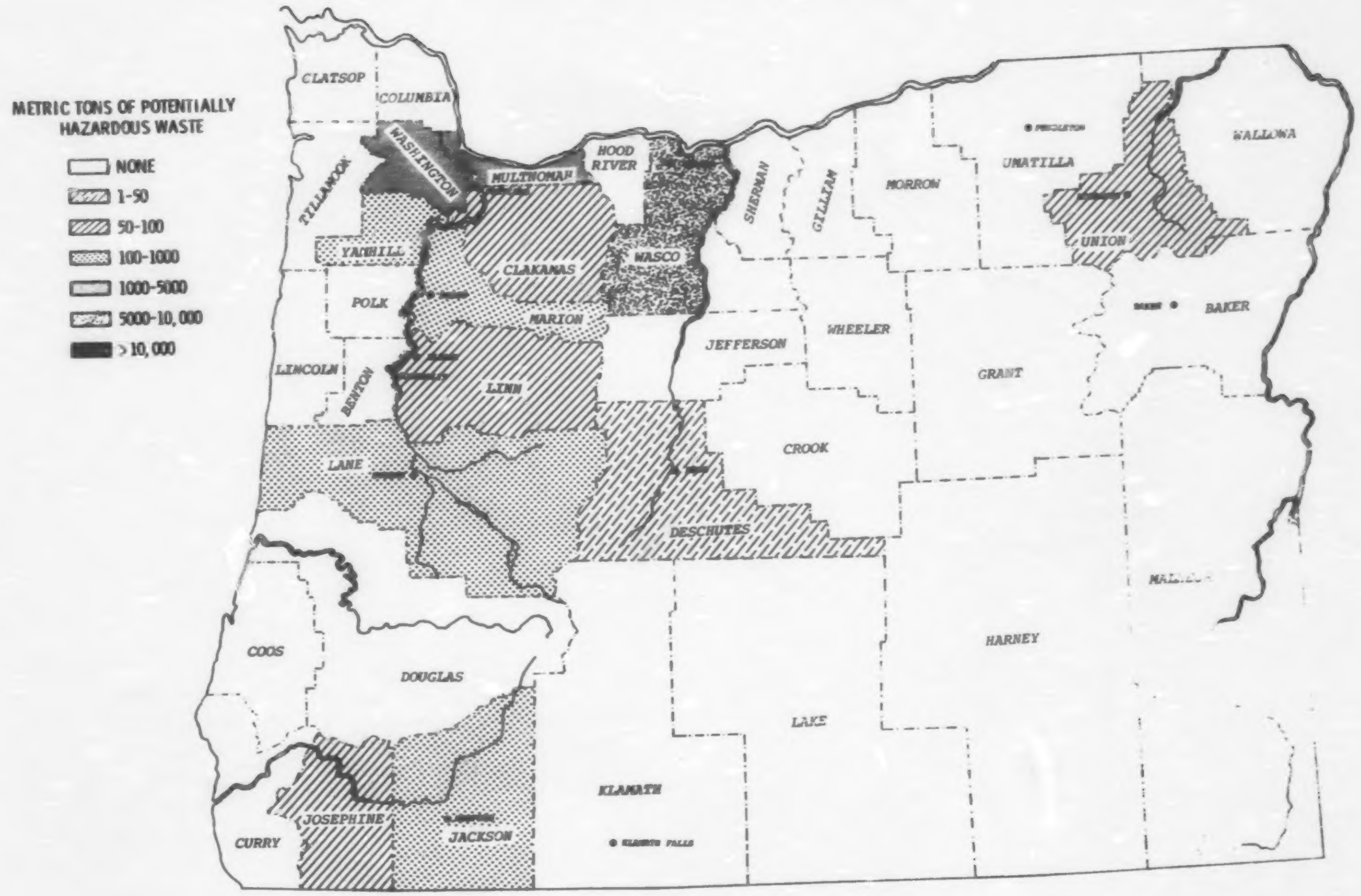
METRIC TONS OF POTENTIALLY HAZARDOUS WASTE
NONE
1-50
50-100
100-1000
1000-5000
5000-10,000
> 10,000
CLATSOP
COLUMBIA
TILLAMOOK
WASHINGTON
MULTNOMAH
HOOD RIVER
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
PENDLETON
UNION
WALLOWA
BAKER
YAMHILL
CLACKAMAS
POLK
MARION
JEFFERSON
WHEELER
GRANT
LINCOLN
BENTON
LINN
CROOK
LANE
DESCHUTES
MALHEUR
COOS
DOUGLAS
HARNEY
LAKE
KLAMATH
KLAMATH FALLS
CURRY
JOSEPHINE
JACKSON

FIGURE V-2. LOCATION OF POTENTIALLY HAZARDOUS INDUSTRIAL WASTE GENERATING ACTIVITIES IN THE STATE OF OREGON

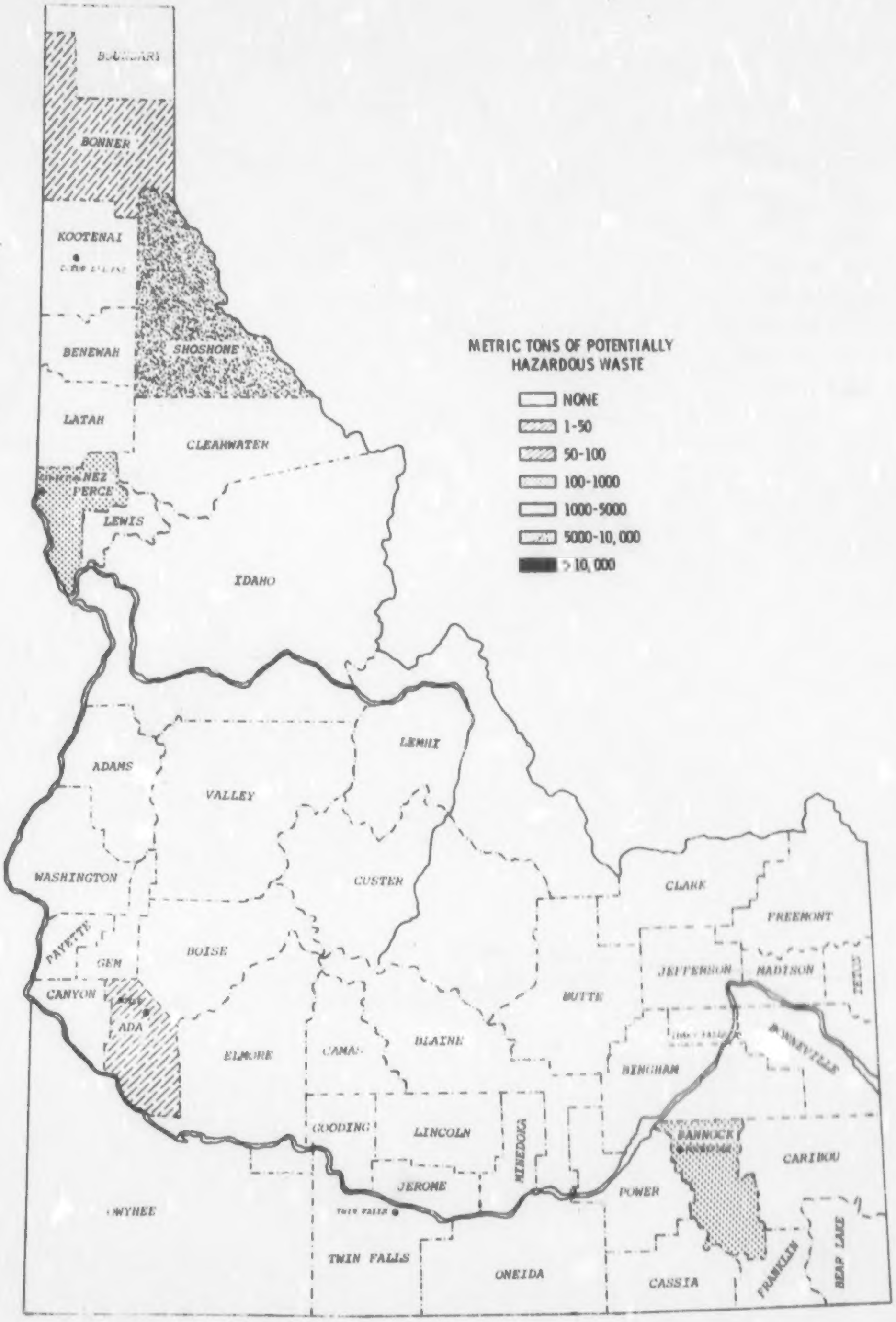
METRIC TONS OF POTENTIALLY HAZARDOUS WASTE
NONE
1-50
50-100
100-1000
1000-5000
5000-10,000
> 10,000
BOUNDARY
BONNER
KOOTENAI
BENEWAH
SHOSHONE
LATAH
CLEARWATER
NEZ PERCE
LEWIS
IDAHO
ADAMS
VALLEY
LEMHI
WASHINGTON
CUSTER
PAYETTE
GEM
BOISE
CANYON
ADA
ELMORE
CAMAS
BLAINE
BUTTE
CLARK
FREMONT
JEFFERSON
MADISON
TETON
BONNEVILLE
BINGHAM
GOODING
LINCOLN
MINIDOKA
JEROME
POWER
BANNOCK
CARIBOU
OWYHEE
TWIN FALLS
ONEIDA
CASSIA
FRANKLIN
BEAR LAKE

FIGURE V-3. LOCATION OF POTENTIALLY HAZARDOUS INDUSTRIAL WASTE GENERATING ACTIVITIES IN THE STATE OF IDAHO

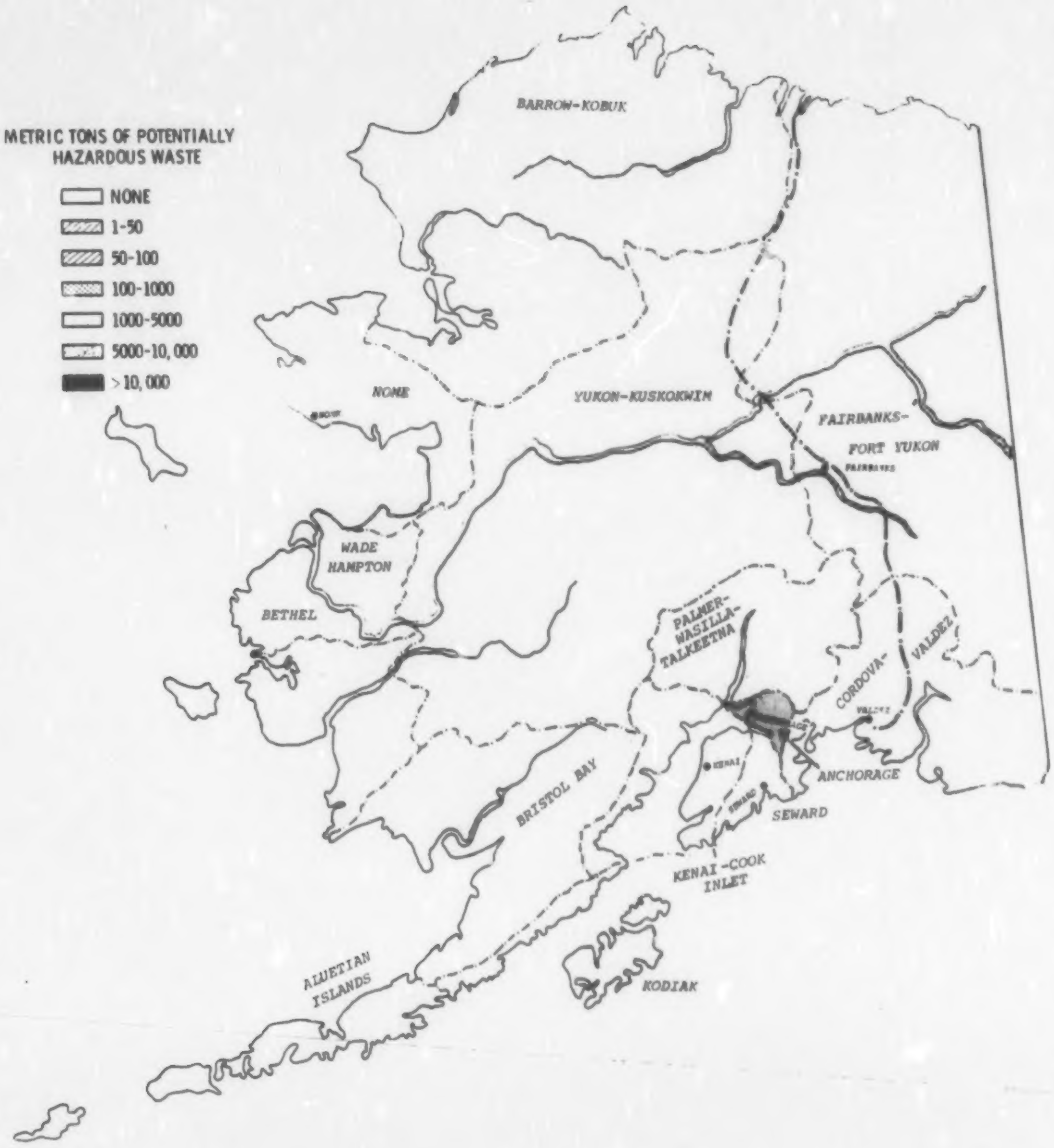
METRIC TONS OF POTENTIALLY HAZARDOUS WASTE
NONE
1-50
50-100
100-1000
1000-5000
5000-10,000
>10,000
BARROW-KOBUK
NOME
YUKON-KUSKOKWIM
FAIRBANKS-FORT YUKON
FAIRBANKS
WADE HAMPTON
BETHEL
PALMER-WASILLA-TALKEETNA
CORDOVA-VALDEZ
VALDEZ
KENAI
ANCHORAGE
SEWARD
BRISTOL BAY
KENAI-COOK INLET
ALUETIAN ISLANDS
KODIAK

FIGURE V-4. LOCATION OF POTENTIALLY HAZARDOUS INDUSTRIAL WASTE GENERATING ACTIVITIES IN THE STATE OF ALASKA

of the maps (Figures V-1 thru V-4) indicate the intensity of total potential industrial hazardous waste generation in the respective counties. Table V-3 gives a further breakdown of the management/disposal practices associated with each waste type in each of the counties for which potentially hazardous industrial waste was identified.

RECOMMENDED WASTE MANAGEMENT PRACTICES

Heavy Metal Sludges and Solutions

Heavy metal sludges and waste solutions arise from electroplating, anodizing, and etching operations. In Region X, these operations were identified in the newspaper publishing, electronic components, electroplating (job shop), and a miscellaneous manufacturing industries reported in Table V-1. The wastes from these operations contain a variety of metals including cadmium, chrome, zinc, copper, and nickel in the form of waste water treatment sludges (precipitated metal salts and hydroxides) and spent or contaminated solutions with the metals in the ionic form. Additionally, exhausted ion exchange resin and electroplating bath filter solids are two potentially hazardous wastewater treatment residuals associated with some electroplating operations.

Other industries in the region producing heavy metal bearing wastes include leather tanning (chromic hydroxide sludges), petroleum refining (leaded gasoline tank bottoms) and lead-acid battery manufacturing (lead oxide wastewater treatment sludge).

Recovery of the metals, either in the elemental form or as a marketable salt should be practiced where it is economically feasible to do so. This may be accomplished prior to conversion of the waste to a sludge as in the case of chromate recovery from plating waste through ion exchange.[50] Recovery of metals from sludges can be undertaken by acid leaching processes.[1] The resultant salts may be of commercial value without further processing or may be purified or treated to recover the metal.

Incorporation of waste heavy metal salts and solutions into saleable products is an alternative to recovery. Western Processing Company (see Chapter VII) located in Kent, Washington, has developed a number of processes utilizing this concept. These include the following:

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[50] Dvorin, R. "Water and Waste Treatment -- A Review of Methods for the Metal Finishing Industry," Chemcial Engineering Progress, No. 2, 1970.

- A fertilizer additive produced from waste sulfuric acid and steel mill flue dust.
- Liquid zinc sulfate produced from waste sulfuric acid, flue dust, zinc ash and galvanizing skimmings.
- Fire retardant produced from waste zinc oxide and chromic-sulfuric acid.
- Ferric chloride suitable as an asphalt conditioner which is produced from flue dust and waste muriatic acid.
- Lead chromate from chrome contaminated rinse water and lead wastes from battery manufacturing plants.

The suitability of a heavy metal bearing waste to reprocessing and/or recovery depends on a variety of economic and technical factors such as marketability of the product, waste volume and composition, and source reliability. The decision to reprocess or recover must be made on a case by case basis.

The recommended disposal method for non-reprocessable heavy metal sludges is discharge to a secured landfill perferably in an arid region where leaching action is negligible.[1] Discharge to a wet region secured landfill will require assurance that the sludge is in a form which will not be subject to significant leaching (low solubility oxides, hydroxides or sulfides) of the heavy metals contained therein. Fixation of the metals in the sludge can be accomplished by incorporating the sludge in a suitable matrix such as asphalt.[51]

At the present time, forty-six percent of the 8,638.4 metric tons of heavy metal waste identified in the regions is being reprocessed by the generators or a waste processing company.

Solvents and Oils

Solvent and oil* wastes are common to a number of industries in Region X. Industries producing these wastes include newspaper publishing, organic and inorganic chemicals, paint and allied products, explosives and munitions, printing inks, electrical and electronic products, plus a variety of miscellaneous manufacturers.

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*The reader should recall from Chapter III that oil wastes were excluded from the study; however, in some instances reporting industries were unable to differentiate between the two.

[51] Blanco, R. E., H. W. Godbee, and E. J. Fredrick. "Incorporating Industrial Wastes in Insoluble Media," Chemical Engineering Progress, No. 2, 1970.

Recovery of waste solvents and oils for reuse is commonly practices throughout the country. Fractional distillation is typically employed to recovery waste solvents[1] while chemical treatment and distillation is used to recover waste oil.[52] Waste oil is also frequently re-used as fuel or as a dust preventative (e.g., road oiling). Solvent recovery residues should be incinerated. Incineration is the recommended disposal alternative for waste solvents and oils where recovery is not feasible.[2] Waste solvents containing chlorinated hydrocarbons require specially design incinerators to cope with the hydrochloric acid evolved.[53] The hydrochloric acid may be recovered for re-use[54] but is most frequently scrubbed from the incinerator off-gas and neutralized. The resultant salt, e.g., ($CaCl_2$), may be of value for application to icy roadways.

Of the 1,166.4 metric tons of solvent and oil waste identified in Region X, 79 percent is presently reported as being recycled internally or through a waste processor.

Caustic and Acid

Like solvents and oils, caustic and acid wastes are common to many industries in Region X. Wastes of this nature were identified in the newspaper publishing industry, the industrial gas (acetylene) industry, the explosives and munitions industry, the primary and secondary non-ferrous metals industry, the electrical and electronics industry, and in a variety of miscellaneous manufacturing industries.

Recycle or re-use of waste caustic and acid is the most desirable form of waste management. In some instances, such as high grade acid used for dehydration and purification purposes, the effluent from one process can be resold as a lower grade product for re-use in another process.

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[52] Weinstein, H. J. "Waste Oil Recycling and Disposal," Environmental Protection Agency Report, EPA-670/2-74-052, August 1974.

[53] Santoleri, J. J. "Chlorinated Hydrocarbon Waste Disposal and Recovery Systems," Chemical Engineering Progress, No. 69, pp. 68-74, July 1973.

[54] Hulswitt, C. "Hol Recovered from Chlorinated Organic Waste," Chemical Engineering, pp. 80-81, May 15, 1972.

In other instances, caustic produced as a by-product (as in acetylene production), can be used for wastewater treatment. More exotic uses of waste caustic and acid such as those practiced by Western Processing Company (see Chapter VII) are also available. Waste acids may also be of value as a leaching agent for metal sludges for which recovery of valuable metals is intended.

Neutralization of waste acid and caustic should be employed in those instances where re-use of recycle is not feasible. Waste processors are in an excellent position to effect this form of treatment due to their access to supplies of both caustic and acid wastes. Neutralization for discharge to receiving waters requires careful control to assure that the pH of the resulting solution is within acceptable limits.

Of the 21,676.9 metric tons of waste acid and caustic identified in Region X, 80 percent was being recycled or sold as a lower grade product and 11 percent was being handled by a waste processor.

Inorganic Chemical Wastes

For the purposes of this report, inorganic chemical wastes are defined as a variety of sludges and solutions whose potentially hazardous constituents are primarily inorganic chemicals which have not been classified generically as heavy metal sludges, acids, caustic, or paint wastes. For Region X these wastes include the following:

- Non-heavy metal salts from inorganic chemical plants (fluorides, sulfides, etc.).
- Catalysts from petroleum refineries.
- Spent potliner and potliner processing residues from aluminum reduction plants.
- Wastewater treatment sludges from non-ferrous metal smelting plants.
- Cyanide solutions from metal fabrication and heat treating plants.

Inorganic chemical wastes represent a diverse group of materials to which no one treatment or disposal scheme may be optimal in a given situation. Recovery of valuable materials may be possible under certain conditions (e.g., high concentrations). For example, wastes containing sufficient cyanide can be treated with acid to volatilize the cyanide or hydrogen cyanide gas which is subsequently captured in a sodium hydroxide solution to form relatively pure sodium cyanide. Wastes containing low concentrations of cyanide may require much larger amounts of acid to release the hydrogen cyanide gas, therefore, making the recovery process uneconomical.

Treatment of potentially hazardous inorganic wastes will generally involve oxidation, reduction, neutralization, and/or precipitation to render harmless the toxic agents contained in the wastes. Cyanides, for example should be chemically oxidized[55] (e.g., by chlorine) or biochemically oxidized[56] (e.g., secondary treatment) to harmless substances. Fluorides should be precipitated with lime or other calcium compounds to form calcium fluoride[57] thus reducing the availability of the toxic fluoride ion. The availability of the fluoride ion can be further reduced by precipitating apatite type substances such as calcium fluoro apatite[58] by the following reaction:

$$3HPO_4^{-2} + 5Ca^{+2} + 3OH^- + F^- \rightarrow Ca_5(PO_4)_3F + 3H_2O$$

As indicated in Table V-I, relatively large quantities of potentially hazardous cyanide and fluoride bearing solid wastes are generated by the aluminum industry. These wastes require further characterization to determine the availability of the toxic agents contained therein. It is possible that lagooning of these wastes may accomplish destruction of the relatively low concentrations of cyanide through biochemical or photochemical oxidation.

Aluminum plants located in arid regions can make use of secured landfills to dispose of cyanide and fluoride bearing wastes; however, this option would probably not be economically feasible for plants located in regions of high precipitation. Recovery of cryolite, Na_3AlF_6, is practiced by one plant which serves to recycle much of the waste fluoride back to the reduction process; nevertheless, the resulting residue still contains fluorides and cyanides. This plant processes its own potlining and scrubber waste for cryolite recovery and accepts some off-site wastes but lacks sufficient capability to process all of the spent potlining generated in Region X.

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[55] Battelle Memorial Institute. "An Investigation of Techniques for Removal of Cyanide from Electroplating Wastes," Environmental Protection Agency, 12010 EIE, November 1971.

[56] Howe, R. H. L. "Recent Advance in Cyanide Waste Reduction Practice," 18th Industrial Waste Conference, Purdue University, 1963.

[57] Rohrer, K. L. "Lime, $CaCl_2$ Beat Fluoride Wastewater," *Water and Wastes Engineering*, pp. 66-68, November 1974.

[58] Skripach, T., et al. "Removal of Fluorine and Arsenic from the Wastewater of the Rare-Earth Industry," Proceedings of the 5th International Water Pollution Research Conference, III 34/1 - 34/7, July - August 1970.

In Region X, inorganic chemical wastes represented 59 percent of the regional total report in Table V-1. Of this 59 percent (77,467 metric tons), 51 percent is being sent to on-property holding lagoons and 48 percent is being stored on company property. Less than 1 percent of the inorganic chemical waste is being recycled or processed by a waste processor.

Organic Chemical Waste

A variety of potentially hazardous wastes identified in Region X have been reported under this heading. Those identified wastes whose potentially hazardous contituents are organic chemicals and which do not qualify as pesticides, explosives, or solvents have been assigned to this category. Inspection of Table V-I shows that wastes in this category include phenolic sludges and residues, chlorinated hydrocarbons, oxazolodine, benzoic acid, and miscellaneous tank washings originating primarily in the petroleum refining and organic chemicals industry.

Although a wide variety of potentially hazardous organic wastes have been identified, this type of waste can be rendered harmless by one process -- incineration.[2] This can be readily accomplished in a properly designed incinerator which subjects the organic waste to a temperature sufficient to complete the combustion process. Scrubber systems must also be included to remove substances such as hydrochloric acid from the off-gas of the incinerator. The incinerators can be designed to accept different types of waste packages including metal drums.

Alternative treatment methods include biological degradation by either secondary treatment (e.g., aerated lagoon) or by land spreading. Monitoring would be required in this instance to assure adequate degradation of the hazardous substances.

Chemical or physical alterations of the organic hazardous wastes may also be possible to render the material harmless for discharge or landfilling. An example is phenolic resin manufacturing sludge which becomes quite impervious to water leaching of phenol after drying.[14]

Treatment by activated carbon sorption is an acceptable alternative for use in treating wastewater containing hazardous organics.[59] The organics sorbed by the carbon are subsequently destroyed during the thermal carbon regeneration process.

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[59] Erskine, D. B. and W. G. Schuliger. "Activated Carbon Processes for Liquids," Chemical Engineering Processes, Volume 67, No. 11, November 1971.

In Region X, 27 percent of the organic chemical wastes are being recycled or processed by a waste processing company. None of the industrial organic chemical wastes identified in the study are being incinerated.

Pesticide Wastes

Pesticide wastes from industrial operations in Region X arise from pesticide manufacturing and wood treating. The former operation produces wastes in the form of manufacturing residues, and off-spec batches while the wood treating industry generates a waste sludge composed of debris contaminated with pentachlorophenol (PCP) and creosote. Contaminated packaging and containers constitute another potentially hazardous waste from both of these industries.

Incineration is the recommended method of disposal for pesticide wastes.[1] This is one of the few available treatment methods which effects almost complete destruction of the environmentally persistent chlorinated hydrocarbon and organophosphate pesticides. No facility for the incineration of pesticide wastes presently exists in Region X. Other less suitable methods for the detoxification of pesticide waste include treatment in oxidation ponds and soil degredation. Oxidation ponds have been shown to degrade 2,4-d and 2,4,5-T with retention times on the order of several days.[60] Other studies have shown effective degradation of the same phenoxy herbicides by soil organisms when these wastes were applied to the soil surface in a controlled manner. Times required to achieve degradation of the herbicides were on the order of several months.[61,62] An attempt to apply this type of treatment of a full-scale basis should be preceeded by pilot studies and carefull consideration of local environmental conditions to assure that release of applied pesticide to surface waters (through runoff) or groundwater (through infilteration) will not occur.

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[60] Atkins, P. R. "The Pesticide Manufacturing Industry -- Current Waste Treatment and Disposal Practices," EPA Water Pollution Control Research Series 12020 FYE, 1972.

[61] Norris, L. A. "Chemical Brush Control: Assessing the Hazard," Journal of Forestry, Vol. 69, p. 715, 1971.

[62] Young, A. L., et al. "Bioassay Studies of Soil Cores from Test Area C-52A, Elgen Air Force Base," Abstracts (No. 72) of the National Meeting of the Weed Science Society of America, St. Louis, Missouri, 1972.

Polychlorinated biphenyls (PSB's) constitute a special class of chlorinated hydrocarbons since they require extremely high temperature for thermal destruction. The best available disposal practice for these materials is shipment to the Monsanto facility in St. Louis or a facility with similar residence time-temperature capabilities.

Seventy percent (645.7 metric tons) of the annual industrial pesticide waste generated in Region X is being dumped at the Wes Con Site in Owhyee County, Idaho (see Chapter VII). "Landfilling" of persistent pesticide wastes is not usually destroyed or rendered non-toxic in an anaerobic environment. No significant degradation of the wastes dumped at the Wes Con Site is expected; however, local environmental conditions in combination with the physical characteristics of the site should preclude the release of the wastes for the foreseeable future.

Paint Wastes

Paint wastes as reported herein refer to wastewater treatment sludges from paint manufacturing plants and paint stripping sludges and solutions from some of the miscellaneous manufacturers. Pigment bags from paint manufacturing plants have been classified as potentially hazardous wastes and are included under the heading of "Paint Wastes".

The degree of hazard associated with paint wastes is primarily a function of the pigment material. A recent study[32] indicates that approximately 5.8 percent of the pigments currently used in paint manufacturing are potentially hazardous. Recovery of these hazardous constituents from complex sludges is not always feasible; however, recycle of tank washings (the origin of most paint sludges) to subsequent batches is an effective means of controlling waste volume. A number of instances of this practice were identified in Region X. Those potentially hazardous sludges which cannot be recycled should be landfilled using the same guidelines as those outlined for heavy metal sludges earlier in this section. Bagging material contaminated with potentially hazardous pigments should be segregated from non-hazardous bagging and either incinerated (with proper control to prevent release of airborne heavy metal) or landfill along with the potentially hazardous sludges.

In Region X, 33 percent of the 995 metric tons of paint waste is going to landfill. The remaining 67 percent is being handled by waste processors or waste disposal companies (destination unknown).

Explosive Wastes

The volume of explosive wastes generated in Region X is relatively small (<50 metric tons per year) and arises only in the explosives and munitions industry as shown in Table V-1. Controlled burning or detonation of explosive waste is the most acceptable means of disposal.[2] In Region X, 60 percent of the 44.8 metric tons of identified explosive waste is handled in this manner. The remaining 40 percent, comprised entirely of packaging, is landfilled. This method of disposal is adequate for packaging if it can be shown that residual explosives are not present in sufficient quantities so as to present an explosion hazard.

VI. POTENTIALLY HAZARDOUS WASTES FROM STATE AND FEDERAL AGENCIES

INTRODUCTION

The information presented below describes potentially hazardous wastes generated by state and federal agencies in Region X. This data was collected through direct contacts with the individual agencies.

Wastes identified from these agencies have been grouped into two categories as follows:

- Spent Pesticide Containers
- Industrial Wastes

In addition to these wastes, a special section reporting direct survey results for electric utilities and public utility districts is included. The latter was conducted for the specific purpose of identifying management practices associated with waste polychlorinated biphenyls (PCB) from these operations. Radioactive wastes associated with the Energy Research and Development Administration (ERDA) facilities at Hanford (Benton County, Washington) and Idaho Falls (Bingham and Bonneville Counties, Idaho) are not covered in detail. Adequate treatment of this complex subject was beyond the scope of this report. Extensive information on radioactive waste volumes and management practices is available in the waste management environmental statements[63-65] for these two facilities and the EPA National Hazardous Waste Management Study.[1] The interested reader is referred to these documents.

SPENT PESTICIDE CONTAINERS FROM STATE AND FEDERAL AGENCIES

Spent pesticide containers constitute a potentially hazardous waste issuing from state and federal agencies. Federal agencies within the region are presently operating under recently promulgated Federal regulations on pesticide container

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[63] U. S. Energy Research and Development Administration. "Environmental Statement, Waste Management Operations, National Reactor Testing Station, Idaho."

[64] U. S. Energy Research and Development Administration. "Environmental Statement, Waste Management Operations, Hanford Reservation," Richland, Washington.

[65] U. S. Atomic Energy Commission. "NRTS Waste Management Plan for FY 1975," Idaho Falls, Idaho, July 1974.

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disposal.[66] These regulations recommend the following disposal procedrues for the three major groups of pesticide containers.[67]

- Group I Containers - Combustible containers which formerly contained organic or metallo-organic pesticides, except organic mercury, lead, cadmium, or arsenic compounds, should be disposed of in a pesticide incinerator, or buried in a specially designated landfill, as noted in § 165.8(a); except that small quantities of such containers may be burned in open fields by the user of the pesticide when such open burning is permitted by State and local regulations, or buried singly by the user in open fields with due regard for protection of surface and sub-surface water.

- Group II Containers - Non-combustible containers which formerly contained organic or metallo-organic pesticides, except organic mercury, lead, cadmium, or arsenic compounds, should first be triple-rinsed. Containers in good condition may then be returned to the pesticide manufacturer or formulator, or drum reconditioner for reuse with the same chemical class of pesticide previously contained providing such reuse is legal under currently applicable U. S. Department of Transportation regulations including those set forth in 49 CFR 173.28. Other rinsed metal containers should be punctured to facilitate drainage prior to transport to a facility for recycle as scrap metal or for disposal. All rinsed containers may be crushed and disposed of by burial in a sanitary landfill, in conformance with State and local standards or buried in the field by the user of the pesticide. Unrinsed containers should be disposed of in a specially designated landfill, or subjected to incineration in a pesticide incinerator.

- Group III Containers - Containers (both combustible and noncombustible) which formerly contained organic mercury, lead, cadmium, or arsenic or inorganic pesticides and which have been triple-rinsed and punctured to facilitate drainage, may be disposed of in a sanitary landfill. Such containers which are not rinsed should be encapsulated and buried in a specially designated landfill.

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[66] "Pesticide and Pesticide Containers -- Regulations for Acceptance and Recommended Procedures for Disposal and Storage," U. S. Environmental Protection Agency, 40CFRK5.

[67] Code of Federal Regulations. Title 40, Part 165.9.

- Residue Disposal - Residues and rinse liquids should be added to spray mixtures in the field. If not, they should be disposed of in the manner prescribed for each specific type of pesticide as set forth in § 165.8.

None of the four states within the Region have promulgated regulations on pesticide container disposal. The status of State regulations regarding hazardous waste management and disposal is discussed in Chapter VIII.

Table VI-1 summarizes pesticide usage rates provided by state and federal agencies in Region X. In all cases, the agencies contacted were unable to provide information on the precise denomination of the containers in which these pesticides were received; however, in most instances they were able to determine whether the pesticide was received in dry or liquid form. Given this information it was possible to apply the distribution of pesticide containers[18] used in Chapter IV (Agriucltural) to obtain an estimate of the types and quantity of waste containers. Table VI-1 also reports current waste management and disposal practices for each of the agencies.

INDUSTRIAL WASTES FROM STATE AND FEDERAL AGENCIES

Wastes of an industrial nature are associated with most of the military installations in Region X. The Bonneville Power Administration also generates approximately 568 liters (150 gallons) of waste PCB's per year.[84] Additionally, the General Services Administration expects to start receiving waste transformer oil contaminated with askarel (PCB's) within the next five years. The estimated quantity of this material is 5,678 liters (1,500 gallons) per year.[85] These and other industrial wastes from state and federal agencies are summarized in Table VI-2. Wastes shown in this Table are assigned to waste categories (I-VIII) identical to those used in Chapter V. Table VI-3 summarized potentially hazardous industrial wastes from state and federal agencies on the basis of waste type and management practice.

ELECTRIC UTILITIES AND PUBLIC UTILITY DISTRICTS

Polychlorinated Biphenyls (PCB's) used as an insulating medium in electric power transformers and capacitor cells can become a very hazardous waste when these pieces of equipment fail and are removed from service. In order to determine management practices associated with this particular waste 157 utilities and public utility districts (PUD's) in the four state region were contacted by letter and asked to indicate if they handled this material. Utilities and PUD's in Region X were asked to estimate how much of the material required disposal per year and what procedures were used to dispose of the material. Seventy-three responses were received. These responses can be summarized as follows:

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[84] Personal communication, Portland Office Bonneville Power Administration, October 1974.

[85] Personal communication, Mr. Lester R. Myers, Jr., Regional Commissioner, Region X, General Services Administration, Auburn, Washington 98002.

- 45 indicated that to date no disposal of PCB's had been required or they did not handle PCB's.
- 9 indicated no disposal to date but:
  - a. 5 would return to manufacturer
  - b. 1 would put in sanitary landfill
  - c. 1 would sell to junk dealer (entire cell)
  - d. 1 would turn it over to Resource Recovery, Inc.
- 19 responded that they had experienced the need to dispose of PCB's and have acted by:

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[75] Personal communication, Mr. David A. Graham, Director, Insect and Disease Control, U. S. Forest Service, Region VI, November 13, 1974.

[76] Personal communication, Mr. Roy W. Jump, Maintenance Supervisor, Division of Highways, State of Idaho Transportation Department, April 24, 1975.

[77] Personal communication, Mr. Wayne Heiskari, Idaho Public Health Department, May 13, 1975.

[78] Personal communication, Mr. Al Atchison, Idaho Department of Public Lands, April 28, 1975.

[79] Personal communication, Mr. John N. Hams, Operations Director, Forest Management Division, Oregon State Forestry Department, September 26, 1974.

[80] Personal communication, Mr. Joe Hay, Agronomist, Oregon State Highway Division, September 26, 1974.

[81] Personal communication, Mr. Allen Erikson, Washington State Department of Natural Resources, April 21, 1975.

[82] Personal communication, Mr. Robert L. Beoger, Landscape Artchitect for Maintenance, Washington State Highways, April 28, 1975, (letter), January 8, 1975.

[83] Personal communication, Mr. Roy Russel, Washington Department of Social and Health Services, January 8, 1975.

a. Storing the material -- 5 utilities ∿ 189 l (50 gal) in storage

b. Shipping the material back to the manufacturer -- 3 responses, 1,173 l (310 gal)/year

c. Sending it to Wes Con, Inc. for disposal -- 1 response, 265 l (70 gal)/year

d. Using it for road oiling -- 2 responses, 549 l (145 gal)/year

e. Selling to junk dealer -- 3 responses, < 57 l (15 gal)/year

f. Burying or landfilling it -- 3 responses, < 95 l (25 gal)/year

g. Shipping out of state (ambiguous) -- 2 responses, 1,136 l + (300 gal)/year

These responses, although representing only half of the electric utilities and PUD's in the region indicate that proper disposal of PCB's is not universal. PCB's should either be returned to the manufacturer (Monsanto) or disposed of in a specially approved site such as Wes Con. Road oiling, public landfills, and junk dealers are not considered proper disposal routes for this material.

TABLE VI-1

ESTIMATE OF SPENT PESTICIDE CONTAINERS FROM STATE AND FEDERAL AGENCIES

Agency	Annual Pesticide Usage		Estimated Number of Pesticide Containers					Current Management/ Disposal Practices
	Dry Units (tons/yr)*	Liquid Units (10^3 gal/yr)**	50 lbs bags	55 gal drums	30 gal drums	5 gal Pails	1 gal Bottles	
Bonneville Power Administration[68,69]	119.8	18.1	4,792	27	336	1,187	272	Containers are triple-rinsed and landfilled.
Bureau of Land Management[70-73] (see note a)	61.8	4.1	2,473	6	76	269	62	Containers are triple-rinsed and landfilled.
U. S. Army Corp of Engineers[74]	No significant pesticide usage.							
U. S. Forest Service[75] (Region X), (see note b)	4.8	9.6	192	14	178	630	144	Containers are triple-rinsed and landfilled. In Oregon they are buried on Forest Service Land.
Idaho Department of Transportation -- Division of Highways[76]	3.5	3.2	140	5	59	210	48	Landfill -- triple-rinsing not required.
Idaho Public Health Department[77] (Mosquito Control)	1.0	4.2	40	6	78	276	63	Landfill -- triple-rinsing not required. Metal outcoming returned to manufacturer.
Idaho Department of Public Lands[78]	No significant pesticide usage.							Metal containers are triple-rinsed prior to land disposal. Some recycle of metal containers is also practiced. Combustible containers are usually burned at the application site.
Oregon Department of Forestry[79]	Quantities not available.							

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*1.0 tons = 0.91 metric tons
**1,000.0 gallons = 3,785.4 liters

TABLE VI-1 (Cont'd.)

Agency	Annual Pesticide Usage		Estimated Number of Pesticide Containers					Current Management/ Disposal Practices
	Dry Units (tons/yr)*	Liquid Units (10^3 gal/yr)**	50 lbs bags	55 gal drums	30 gal drums	5 gal Pails	1 gal Bottles	
Oregon State Highway Division[89]	78.4	7.6	3,137	11	141	499	114	Landfill or burning. Triple-rinsing recommended, but not required by formal directive.
Oregon -- Mosquito Control (see note c)	4.5	7.9	180	12	146	518	119	Not determined.
Washington Department of Natural Resources[81]	8.4	7.9	336	12	146	518	119	Containers are triple-rinsed and landfilled. DNR attempts to recycle metal drums.
Washington State Highway Commission -- Department of Highways[82]	57.0	13.9	2,278	21	258	912	209	Containers are triple-rinsed and landfilled.
Washington Department of Local and Health Services (Mosquito Control)[83] (see note d)	4.5	7.9	180	12	146	518	119	Container disposal practices by local Mosquito Control Districts are unknown.
Total	343.7	84.4	13,748	126	1,564	5,537	1,269	

NOTES TO TABLE VI-1

a. Data reported in table is for Oregon and Washington. The BLM in Idaho[71] reported that very little "chemical work" has been done over the last few years. Some 2,4-D has been used recently for weed control involving 2-3 hundred acres. The BLM in Idaho uses the Wes Con site (see Chapter VII) for disposal of all used pesticide containers.[71] The Bureau of Land Management in Alaska does not apply pesticides; however, an unknown amount of pesticides are used by permitees on some sites within lands administered by the BLM.[72]

b. Not included in the table is 102, 882 kilograms (226, 815 lbs) of DDT[75] used to control a widespread tussock moth infiltration in the forests of eastern Oregon and Washington during FY 74.

c. Mosquito Control in Oregon is handled by local mosquito Control Districts. No centralized source of data could be found to indicate annual pesticide usage by local districts. Usage reported in Table VI-1 is an estimate based on usage reported by local mosquito control districts in Washington.

d. Like Oregon, Mosquito Control in the State of Washington is carried out through a number of local Mosquito Control Districts. However, the Washington Department of Social and Health Services maintains records of pesticide usage by the various districts and reports these figures annually.[83]

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[68] U. S. Department of the Interior, Bonneville Power Administration. "Environmental Statement FY 1975 Proposed Program," August 23, 1974.

[69] Personal communication with Mr. Fred Gross, Head, Transmission Line Maintenance BPA, Vancouver, Washington, October 9, 1974.

[70] Personal communication, Mr. Maxwell T. Lieurance, Chief, Division of Resources, Oregon State Office, Bureau of Land Management, November 8, 1974.

[71] Personal communication, Clair M. Whitlock, Associate State Director, Idaho State Office, Bureau of Land Management, June 3, 1975.

[72] Personal communication, Mr. Jules V. Tileston, Chief, Division of Resources, Anchorage Office, Bureau of Land Management, June 19, 1975.

[73] Personal communication, Mr. Bill Mathews, Oregon State Office, Bureau of Land Management, May 21, 1975.

[74] Personal communication, Mr. Brian R. Appleburry, Emergency Operations Planner, Seattle District, U. S. Army Corps of Engineers, May 29, 1975.

TABLE VI-2

ESTIMATE OF HAZARDOUS WASTES FROM STATE AND FEDERAL AGENCIES

Activity Generating	Waste Category	Description of Waste	Quantity Per Year	Current Disposal/ Management Practice
Fairchild Air Force Base (Washington)[86]	IV	Photo chemicals	6,246 ℓ/yr (1,650 gal/yr)	Sewer to treatment plant
	V	Chlorinated hydrocarbons	318 ℓ/yr (84 gal/yr)	Evaporation
	V	Cleaning compounds	25,438 ℓ/yr (6,720 gal/yr)	Oil skimming pond -- sewage treatment plant
	II	Solvents	32,751 ℓ/yr (8,652 gal/yr)	Oil skimming pond -- sewage treatment plant
	VII	Paint and thinner	681 ℓ/yr (180 gal/yr)	Landfill
		Oil[(a)]	57,008 ℓ/yr (15,060 gal/yr)	Off-base recycle (78%) On-base recycle (22%)
	III	Acid-caustic	3,907 ℓ/yr (1,032 gal/yr)	To sewage treatment plant
	VIII	Munitions	5-272 kg/yr (12-600 lbs/yr)	Detonate/burn
Mountain Home Air Force Base (Idaho)[87]	No hazardous wastes reported.			
McChord Air Force Base (Washington)[88]	No hazardous wastes reported.			
U. S. Army, Fort Lewis (Washington)[1]		Radioactive materials	<545.5 kg/yr (<1200 lbs/yr)	See note 1
	I	Spent chromic acid	373 ℓ/yr (100 gal/yr)	Neutralized/reduced sludge to landfill
	II	Solvents	2,646 ℓ/yr (700 gal/yr)	Sold to off-base waste processor
	III	Spent acid and caustic	36,439 ℓ/yr (9,640 gal/yr	Neutralized sewer to treatment plant
	IV	Spent photo chemicals	1,587.6 ℓ/yr (420 gal/yr)	Sewer to treatment plant
	VI	Excess insecticide: 10% DDT, 5% DDT, pyrithin	6,643 kg/yr (14,615 lbs/yr)	In storage awaiting disposal instructions
	VI	Excess herbicides 7.12% disodium tetrahydrate	159 kg/yr (350 lbs/yr)	In storage awaiting disposal instructions

TABLE VI-2 (Cont'd.)

Activity Generating	Waste Category	Description of Waste	Quantity Per Year	Current Disposal/ Management Practice
Madigan Army Medical Center	V	Infectious hospital waste	330 MT/yr (364 tons/yr)	Incinerated
		Medical radioactive materials	5,896.8 ℓ/yr (1,560 gal/yr)	See note 2
Elmendorf Air Force Base (Alaska)[2]	III	Sodium hydroxide	19,300 kg/yr (42,460 lbs/yr)	Neutralize/sewer
	II	Morpholine	6,400 kg/yr (14,080 lbs/yr)	Sewer
	III	Sulfuric acid	25,500 kg/yr (56,100 lbs/yr)	Neutralize/sewer
	V	Cyclohexylamine	2,190 kg/yr (4,818 lbs/yr)	Sewer
	IV	Inorganic film processing chemicals	736 kg/yr (1,619 lbs/yr)	Sewer
	V	Organic film processing chemicals	593 kg/yr (1,304 lbs/yr)	Sewer
	IV	Film processing chemicals containing cyanides	270 kg/yr (594 lbs/yr)	See note 3
	III	Ammonium hydroxide	925 kg/yr (2,035 lbs/yr)	Sewer
	II	Stripping solvents	17,424 kg/yr (38,332 lbs/yr)	See note 4
	VI	Waste pesticides	657 kg/yr (1,445 lbs/yr)	See note 5
Eielson Air Force Base (Alaska)[3]	V	Antifreeze	1,588 ℓ/yr (420 gal/yr)	Recovered and sold on base
	IV	Aircraft soap	4,173 ℓ/yr (1,104 gal/yr)	Sanitary sewer
	II	Sulfuric acid	1,814 ℓ/yr (480 gal/yr)	Severed
	VII	Paint wastes	1,564 ℓ/yr (414 gal/yr)	Severed

TABLE VI-2 (Cont'd.)

Activity Generating	Waste Category	Description of Waste	Quantity Per Year	Current Disposal/ Management Practice
U. S. Naval Shipyard, Bremerton, Washington[45] (see note b)	III	Acid and caustic tank solutions	37,854 ltr (10,000 gal)	See note c
	III	Phosphoric acid	7,192 ltr (1,900 gal)	
	IV	Sodium nitrate/ phosphate	15,142 ltr (4,000 gal)	
	VII	Sodium hydroxide (paint strip)	24,605 ltr (6,500 gal)	
	IV	Oakite solutions	18,549 ltr (4,900 gal)	
	I	Anodizing solution (non-chromated)	5,300 ltr (1,400 gal)	
	III	Aluminum bright dip (nitric & phosphoric acid)	3,407 ltr (900 gal)	
	VII	Waste paint & solvent	113,562 ltr (30,000 gal)	
	I	Plating solution (Cr, Ni, Cu, CN. Sn, Au)	31,797 ltr (8,400 gal)	
	I	Liquid lead	379 ltr (100 gal)	
	I	Aluminum & nickel strip	1,333 ltr (405 gal)	
	I	Aluminum iridite solution	15,142 ltr (4,000 gal)	
	II	Epoxy strip solution	568 ltr (150 gal)	
	I	Anodize chrome	644 ltr (170 gal)	
	II	Solvent	9,464 ltr (2,500 gal)	
	VII	Paint booth washwater residue	6,435 ltr (1,700 gal)	

TABLE VI-2 (Cont'd.)

Activity Generating	Waste Category	Description of Waste	Quantity Per Year	Current Disposal/ Management Practice
Naval Air Station, Whidly Island (Washington)[93]	II	Chlorinated solvents	4,542 ltr (1,200 gal)	See note d
	II	Freon PCA	6,814 ltr (1,800 gal)	
	VII	Used varnish	946 ltr (250 gal)	
	II	Ketone, methyl chloride epoxy, polyester mix	757 ltr (200 gal)	
	IV	Photo etch salts	946 ltr (250 gal)	
	IV	Expired chemical inorganic slats	1,622 kg (3,575 lbs)	
	VI	Ethylene diamine	378 ltr (100 gal)	
	I	Battery acid	757 ltr (200 gal)	
	II	Cleaning compound FSN 6850-559-2837 (organic solvent)	4,164 ltr (1,100 gal)	
	II	Corrosion removing compound Mil-C-14460B FSN 6850-550-5568	3,331 ltr (880 gal)	
	II	Carbon removing compound Type 2 Mil-C-19853A, FSN 6850-7473, (organic solvent)	6,662 ltr (1,760 gal)	
	II	Epoxy stripper compound Mil-R-81294A	1,249 ltr (330 gal)	
	II	Tri-Chloro-Ethane Mil-R-812533A	2,498 ltr (660 gal)	
	II	Dry cleaning solvent PD-680	6,246 ltr (1,650 gal)	
Defense Property Disposal Office, Seattle (Washington)		See note e		

TABLE VI-2 (Cont'd.)

Activity Generating	Waste Category	Description of Waste	Quantity Per Year	Current Disposal/ Management Practice
U. S. Naval Hospital Bremerton (Washington)		See note f		
Trident Submarine Base (Washington)		See note g		
Bonneville Power Administration[illegible]	V	Polychlorinated biphenyls (PCB's)	568 ℓ/yr (150 gal/yr)	Secured landfill (see note h)
General Services Administration[illegible]	V	Askarel contaminated oil	5,678 ℓ/yr (1,500 gal/yr)	Future waste -- disposal option not determined

NOTES TO TABLE VI-2

a. Off-base recycling constitutes pumping of contaminated oil tanks by a commercial drain oil service. On-base recycling consists of use of the oil as a fuel supplement.

b. There may be in the aggregate 9,072 kg (20,000 lbs) per year of miscellaneous solvents, outdated chemicals, cleaning agents, photographic developers, etc., of less than 379 liters (100 gal) each, in addition to items listed.[89]

c. Hazardous wastes from Bremerton Naval Shipyard are currently being disposed of by Resource Recovery, Inc. of Seattle under a one year contract with the Navy. This contract does not include oils, petroleum, and hydrocarbon wastes which are presently barged to the Manchester Fuel Division.

d. Present practice for disposal of the indicated wastes is dilution and dumping into a limestone lined acid pit. The station is now investigating methods to provide better disposal or reuse.[90]

e. Hazardous materials received for disposal by the Seattle Defense Property Disposal Office are transfered to the Naval Shipyard in Bremerton. Wastes listed in Table VI-2 for Bremerton Naval Shipyard include those received by the shipyard from the Defense Property Disposal Office.[90]

f. Hazardous wastes comprised primarily of expired drugs, medications, vaccines, and laboratory chemicals from the Bremerton Naval Hospital are presently transfered to the shipyard forge shop for incineration. Although the list of materials in this waste stream is rather extensive, the volume of the potentially hazardous component is quite small.[89] This practice is expected to continue until the new hospital, presently under design, is constructed.[90]

g. Construction of the Trident Submarine Base on the Hood Canal near Bremerton, Washington, has just begun. It is anticipated that this facility will not be operational until 1978 at which time wastes similar to those found at the Bremerton Naval Shipyard can be expected.[90]

h. Polychlorinated biphenyls (PCB's) are used by the BPA as insulating liquids in their capacitor cells. Present BPA standards[91] call for the disposal of ruptured or failed capacitor cells containing PCB at the Wes-Con, Inc. hazardous waste disposal site near Twin Falls, Idaho in Owyhee County.

Note 1 - All waste radioactive material is stored then shipped to AEC land burial site. Appropriate U.S. Army Edgewood Arsenal instructions are followed concerning storage and shipping of radioactive wastes.

Note 2 - Radioactive wastes are stored in 55 gallon drums and surface shipped to Spellman, South Carolina.

Note 3 - Cyanide wastes are processed and recycled. A new biodegradable film process is sought to replace cyanide bleach process.

Note 4 - At present, solvents are either sewered or stored. A reduction is planned on site stripping and corrosion control programs. Plans call for substitution of less hazardous stripping and cleaning compounds.

Note 5 - Temporary storage is provided until an environmentally acceptable disposal can be accomplished.

Additional footnotes

1 - Personal communication, Captain E. L. Jewell, Assistant Adjectant General, Fort Lewis, Washington, January 7, 1976.

2 - Personal communication, Colonel Allan W. Morton, Base Civil Engineer, Elmendorf AFB, Alaska, January 14, 1976.

3 - Personal communication, Lt. Col. James G. Willett, Base Civil Engineer, Eielson AFB, Alaska, December 2, 1975.

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[86] Personal communication, Major Daniel McMahon, Base Civil Engineer, Fairchild AFB, June 10, 1975.

[87] Personal communication, O. S. Williams, Deputy Base Civil Engineer, Mountain Home AFB, Idaho, May 21, 1975.

[88] Personal communication, Mr. Theodore W. Lynn, Deputy Base Civil Engineer, McChord AFB, November 28, 1975.

[89] Personal communication, Mr. Gale B. White, Assistant Environmental Engineer, Seattle Branch, Western Division, Naval Facilities Engineering Command, May 8, 1975.

[90] Ibid., May 27, 1975.

[91] "Failed Capacitor Cells Handling, Storage, Transportation And Disposal," BPA Substitution Maintenance Standard, No. 640(1), March 10, 1975.

TABLE VI-3

INDUSTRIAL WASTES FROM STATE AND FEDERAL AGENCIES

Waste Category	Waste Processor	Wastewater Treatment Plant	Stored on Property	Secured Landfill	Burned or Incinerated	Sanitary Landfill	Recycled or Sold as Product	Total
I. Metal Sludges and Solutions	69.7	-	-	-	-	.5	-	70.2 (77.2)
II. Solvents and Oils	22.4	35.8	21.7	-	-	-	17.4	97.3 (107.0)
III. Caustics and Acids	58.7	96.4	-	-	-	-	-	155.1 (170.6)
IV. Inorganic Chemicals	43.0	7.6	-	-	0	-	.3	50.9 (56.0)
V. Organic Chemicals	.4	25.7	-	.7	330	-	1.4	358.2 (394.0)
VI. Pesticide Wastes	-	-	6.8	-	-	.2	-	7.0 (7.7)
VII. Paint Wastes	173.1	1.9	-	-	-	-	-	175.0 (192.5)
VIII. Explosive Wastes	-	-	-	-	.1	-	-	.1 (.1)
TOTAL MT	367.3	167.4	28.5	.7	330.1	.7	19.1	913.8
T	(404.0)	(184.1)	(31.4)	(.8)	(363.1)	(.8)	(21.0)	(1005.2)

VII. WASTE PROCESSING AND DISPOSAL COMPANIES

Discussion thus far has centered on operations which generate hazardous waste as a result of some other primary activity. As indicated in previous chapters, many of these "generators" have taken steps to reduce the volume of hazardous waste through internal recycle or to ameliorate the hazards of their wastes through various treatment processes. Other activities in the region, external to these sources, provide important services which augment and support the hazardous waste management programs of these primary sources. These other activities can be classified under three headings as follows:

- Waste Processing - Activities which receive hazardous wastes and process them into reusable products. This reprocessing may or may not yield a final waste or hazardous residual requiring disposal.
- Waste Disposal - Activities which provide ultimate disposal for hazardous wastes.
- Waste Removal - Activities which provide transfer services between primary sources of hazardous wastes and disposal/processing operations. Transfers made by these companies may or may not be to authorized or approved disposal sites.

Regional operations under these three headings are discussed below. These evaluations are based on site visits and discussion with the subject companies. In depth monitoring of the internal practices of these companies was beyond the scope of the study.

WESTERN PROCESSING COMPANY
(WASTE PROCESSOR)

Background and Organization

Western Processing Company was founded in 1957 by Mr. Garmt J. Nieuwenhuis. The facility, consisting of a small chemical reclamation/industrial waste processing site, is presently located on 13 acres of prime Kent Valley industrial land near Seattle, Washington. The company employs from 10 to 30 people at any one time. Most of these employees are unskilled laborers. Mr. Nieuwenhuis, now 64 years old, in essence comprises the entire management of Western Processing both from a technical and business point of view. This situation, by his own admission[92] has created certain problems relating to the future of this company. This problem will be discussed more fully in subsequent sections of this report.

The philosophy underlying Western Processing's operation is one of chemical reclamation through the combination and blending of industrial wastes to produce saleable products. The emphasis is on resource recovery as opposed to detoxification and waste disposal.

Waste Streams and Products

The service area covered by Western Processing extends along the West Coast from San Diego to British Columbia; however, the major portion of the waste received by Western Processing is generated in the Seattle - Tacoma area.

The principal wastes received by Western Processing include the following:

- Electroplating solutions and sludges
- Pesticides/Herbicides (relatively small)
- Spent acid and caustic solutions
- Waste oils and solvents
- Battery mud
- Flue dust from secondary smelters
- Aluminum slag
- Galvanization skimmings

Table VII-1 summarized the wastes received by Western Processing over the period April 1974 to April 1975. Products which are produced from the received wastes include the following:

- Zinc ingots
- Ferric compounds for moss control on lawns
- Flame retardants for wood products

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[92] Personal communication, Mr. Nieuwenhuis, President of Western Processing Company, May 7, 1975.

TABLE VII-1

HAZARDOUS WASTES RECEIVED BY WESTERN PROCESSING COMPANY, APRIL 1974 TO APRIL 1975[92]

Waste Material	Quantity
Waste Cyanide Solutions	80,527 ltr (21,273 gal.)
Hexavalent Chrome Solutions	1,480,399 ltr (391,080 gal.)
Trivalent Chrome	378,541 ltr (100,000 gal.) + 379 cu. m. (496 cu. yds.*)
Acid Solutions	854,216 ltr (225,660 gal.)
Caustic Solutions and Sludges	1,025,744 ltr (270,973 gal.)
Metal Salt Solutions and Sludges	103,777 ltr (27,415 gal.)
Oils	333,760 ltr (88,170 gal.)
Solvents	38,980 ltr (10,300 gal.)
Oils and Solvents	297,249 ltr (78,525 gal.)
Paint Sludges	401,726 ltr (106,125 gal.)
Organics Other than Solvents (Phenols, Amines, etc.)	197,258 ltr (52,110 gal.)
Inorganic Chemicals	183,761 Kg (405,125 lbs) + 17,223 ltr (4,550 gal.)

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*Filter cake from industrial wastewater treatment plant.

- Fertilizer additives
- Wood preservative (copper-chromium-arsenate)
- Sodium cyanide
- Fuel oil and recovered solvents
- Zinc sulfate (liquid and pellets)
- Zinc chloride
- Zinc nitrate
- Iron oxide pellets
- Iron sulfate
- Sodium aluminate
- Ammonium sulfate
- Aluminum sulfate
- Copper sulfate
- Copper hydroxide
- Sodium dichromate
- Lead chromate (pigment)

Effluents from Western Processing conform to Washington Department of Ecology standards. Solid residuals, including sludges and occassional pesticide wastes, are mixed with the concrete and used to make blocks which support above ground storage ponds.

Waste Handling and Processing

Waste handling and processing at Western Processing is, for the most part, performed on a batch basis. Wastes are received intermittently and stored in above ground holding ponds for subsequent processing. Present storage capacity is close to six million gallons. Wastes which are received at the facility are immediately characterized and directed to either the above ground storage basin or one of a number of vertical holding tanks.

Operations and processes employed by Western Processing are quite varied. The principal processes and resulting products include the following:

TABLE VII-1

HAZARDOUS WASTES RECEIVED BY WESTERN PROCESSING COMPANY, APRIL 1974 TO APRIL 1975[92]

Waste Material	Quantity
Waste Cyanide Solutions	80,527 ltr (21,273 gal.)
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Inorganic Chemicals	183,761 Kg (405,125 lbs) + 17,223 ltr (4,550 gal.)

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*Filter cake from industrial wastewater treatment plant.

- Green Giant Fertilizer Pellets - This fertilizer additive composed of iron sulfate and zinc sulfate pellets is produced from the addition of waste sulfuric acid to steel mill flue dust (primarily zinc and iron oxide). The main market for this product is the farming country of Eastern Washington and Idaho.

- Zinc Ingots - A small five ton per day smelter is operated by Western Processing. Galvanization skimmings high in zinc are purchased by Western Processing from local galvanizing operations, refined into zinc ingots, and resold to the galvanizers.

- Liquid Zinc Sulfate - This product is produced through the addition of sulfuric acid to flue dust, zinc ash, and galvanization skimmings. Zinc ammonium sulfate can also be produced from the process with the addition of ammonia. The product is used as a growth stimulant for various crops in Eastern Washington and Idaho.

- Type D Fire Retardant - This product is produced from waste zinc oxide and chromic-sulfuric acid. These wastes are combined with ammonia and boric acid (purchased) to produce the fire retardant which is used to treat wood in the housing industry.

- Fuel Oil and Solvents - A solvent recovery system is used to produce Bunker C fuel oil, acetone, naphtha, trichloroethylene, and cellosolve from waste oils and contaminated solvents received by Western Processing.

- Ferric Chloride - This product, used primarily as an asphalt conditioner, is derived from flue dust (high in iron oxide) and muriatic acid. It can also be used for etching printed circuit boards and as a flocculant for water and wastewater treatment.

- Wood Preservative (Copper-Chromium-Arsenate) - Produced by blending plating solutions containing copper and chromium with purchased arsenic acid.

- Aluminum Sulfate - Produced from aluminum slag and purchased sulfuric acid.

- Sodium Cyanide - Plating solutions containing various metal salts of cyanide are acidified with sulfuric acid. The resulting hydrogen cyanide gas is passed through a sodium hydroxide solution to produce reusable sodium cyanide.

- Chromium Wastewater Recovery - This recently patented process uses lead bearing sludge to remove chromium in the form of lead chromate from rinse waters in the metal finishing industry. Installation of this system will essentially preclude the discharge of high volumes of low level chromium solutions from electroplating operations by allowing continuous recycle of the rinse water. The resulting lead chromate can be used as a pigment.

- Ferric Sulfate - Produced by blending waste sulfuric acid and flue dust from steel mills. This product is used as a moss killer.

Evaluation

The value of Western Processing to the overall management of hazardous waste in Region X is evident. Not only does Western Processing provide for substantial reduction of highly toxic and persistent hazardous waste materials which would otherwise require disposal by dumping, but it also has furthered the concepts and practices of reuse and waste exchange in the region. Indeed, the economic conversion of waste materials to usable products is a concept which has been endorsed by many as an effective answer to environmental pollution. However, despite the soundness of the underlying philosophy, and demonstrated workability of its various processing technologies, the future viability of this company is questionable. This circumstance hinges on two major factors: 1) the financial condition of the company, and 2) the almost complete dependence of the company on the continued direction of Mr. Garmt Nieuwenhuis. The conditions surrounding these circumstances have been well documented in a recent study[93] of Western Processing by students of Seattle University under the sponsorship of the Small Business Administration. The reader is referred to the basic document for a complete description. Some of the more noteworthy findings of this study are summarized below.

Financial Condition

Western Processing was initially under-capitalized and is presently undergoing a severe cash shortage. In 1974, current liabilities exceeded current assets by over $55,000. In addition, the State Department of Ecology has identified improvements required to upgrade the environmental acceptability of Western Processing costing around $385,000. These improvements include improved drainage, dikes, relocation of holding ponds, concrete pads, etc., required to comply with state regulations. A five year plan was negotiated with the state to comply with the requirement; however, the business is simply not profitable enough to comply with even the five year plan. Furthermore, these improvements are not expected to add to the profitability of the operation.

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[93] Alexander, M. "Western Processing, Inc.," report submitted to Seattle University, March 15, 1975.

Although the business has shown a profit, capital requirements for equipment and expansion far exceed that provided by annual profits. The annual financial condition of the company is such that additional long-term financing is unlikely.

Cash flow problems stemming from the intermittent nature of the business has forced Western Processing to consistently borrow against each month's sales to meet fixed monthly expenses.

Management Problems

The success or failure of Western Processing hinges on one man, Mr. Nieuwenhuis. As stated in the Seattle University study, "Mr. Nieuwenhuis is Western Processing."[93] Mr. Nieuwenhuis is 64 years old and wishes to retire. In order for the business to continue, a competent replacement, both managerially and technically, must be found. Cessation of operations by Western Processing would represent a loss of a major part of the present hazardous waste management capability in Region X.

CHEMICAL PROCESSORS, INC.
(WASTE PROCESSOR)

Background and Organization

Chemical Processors, Inc. (Chem Pro) is primarily a waste chemical processing and recovery operation. The company was established in 1959 and remained Chemical Processors in 1970 when it underwent a major management change and reorganization. The company is headquartered in South Seattle where it operates a solvent recovery plant. The other major facility of the company, a gravity oil separation plant, is located on Pier 91 on Elloit Bay in Seattle. As noted above, Chem Pro's main line of business is oil and solvent recovery, however, the firm does accept other hazardous wastes usually for subsequent disposal through Resource Recovery, Inc. -- an independent* though closely allied firm. Chem Pro also operates a small subsidary (Chem Pro of Oregon) which practices oil recovery through gravity separation.[94]

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*Chem Pro is the major stock holder of Resource Recovery presently holding 45 percent of the common stock.[94]

[94] Personal communication, Mr. Ron West, Chemical Processors, Inc., May 22, 1975.

Waste Streams and Products

Chem Pro will accept all types of wastes except medical, explosive and radioactive materials. Oil bearing wastes from tankers, gasoline stations, and other sources are handled at the Pier 91 gravity separation facility. Two reusable products results from the oil separation operation:

- Light oil fraction suitable for use as a supplement fuel.
- Heavier oil fraction with some colloidal and suspended solids usable for road oiling.

Chem Pro estimated that they will process close to five million gallons of oil bearing waste this year.[94] Approximately 70 percent of this volume is recoverable (75-95 percent as supplemental fuel).

Wastes for the oil separation facility consist of a sludge composed primarily of inert material which accumulates at the bottom of the oil separation tanks. This sludge is removed periodically, dried, and shipped to Resource Recovery for landfill disposal. Due to the recent termination of operations by Resource Recovery, the sludge from Chem Pro's oil separation facility is being retained in the separation tanks pending approval of a new disposal site for Resource Recovery.

The Chem Pro solvent recovery operation is located at 734 S. Lucile Street in Seattle. The facility consists of a converted paint production plant complete with chemical separation and petroleum fractionation towers. Wastes received at this facility come from a variety of sources and consist of spent of contaminated solvent cleaning solutions, solvent sludges, stripping solutions, etc. Solvents are recovered through evaporation and distillation and result in three basic products.[94]

- Acetone
- Lacquer thinner
- Chlorinated solvents

Chem Pro expects to process close to 500,000 gallons of solvent waste this year. Solvent recovery is about 60 percent. The remaining 40 percent is residual sludge. In the past, this sludge (still considered hazardous) has been disposed of through Resource Recovery. The recent cessation of operation by Resource Recovery has caused Chem Pro to stockpile this material until Resource Recovery can obtain a new site. Mr. Ron West, President of Chem Pro, has recently indicated[94] that his firm is seriously considering the installation of a sludge cooker which would remove and recover the remaining solvents from this sludge and render it suitable for disposal in local, "conventional" landfills.

As indicated previously, Chem Pro will accept other wastes including heavy metal sludges, plating solutions, and pesticides. However, in the handling of these wastes, Chem Pro serves as an intermediary -- the wastes are merely accepted by Chem Pro and then transferred to another company such as Recource Recovery whose operations are geared to process and disposal of these types of wastes.

Economics

Charges for oil separation are fairly standard. Chem Pro pays its customers \$0.02 per gallon of oil recovered and charges \$0.025 for each gallon of water received with the oil. Recovered fuel oil is currently selling for \$0.18 - \$0.20 per gallon.[94]

Charges for solvent recovery and other hazardous wastes are usually handled on a quotation basis. Chem Pro has established reciprocal agreements with its customers whereby solvent wastes are processed and the recovered fractions returned to the customer for a fixed processing charge (∿ \$0.30 - \$0.40 per gallon). For "casual drums" delivered to the Chem Pro plant in Seattle, the nominal charge is \$3.00 - \$20.00 per drum depending on the nature of the material.[94]

Chem Pro, in combination with Resource Recovery, is capable of providing a full spectrum of hazardous waste handling and disposal services. The management of Chem Pro appears to be growth oriented as evidenced by their recent acquisition in Oregon. As Chem Pro is a major stock holder in Resource Recovery, Inc., continued failure of this company to site a hazardous waste disposal facility may present some problems to Chem Pro.

WES CON, INC.
(WASTE DISPOSAL)

Background and Organization

Wes Con is an Idaho corporation which operates a chemical disposal and recycling center. Headquartered in Twin Falls, Idaho, the principal holding of the corporation is an abandoned missile base located in Owyhee County approximately 10 miles west of Grandview, Idaho. The primary working area of the 100 acre site consists of a 17 acre former missile launching complex secured by a nine foot, climb-proof, chain-link fence Located within this area are a series of abandoned missile silos and tunnels which are now used to encapsulate and retain hazardous wastes. The site is intermittently operated for disposal depending on business volume; however, 24 hour surveillance of the site is provided.

Waste Streams

Wes Con accepts any wastes except radioactive materials, poison (military) gas and pressurized gas. Recently, volume has been averaging 40 tons per week and business has been improving steadily in the last year.[95] Much of the volume at Wes Con's is in the form of used pesticide containers and pesticide manufacturing wastes. The company is also handling most of the waste PCB's from the region through arrangements with the major power companies and the BPA.[95] Table VII-2 summarizes wastes received by Wes Con for the period February 1974 through August 1975.

Handling and Processing

Materials destined for disposal by Wes Con are transported to the site via common carrier. Customers are given the option of selecting the carrier. Since Wes Con does not maintain a chemical analysis laboratory at the site, the customer is required to provide certification of the contents of his shipment prior to acceptance of the material by Wes Con.

Wastes received at the site are disposed of immediately. Disposal consists of unloading the contents of incoming trucks directly into one of the silos or tunnels. The silos are approximately 150 feet deep. The walls are constructed of six foot thick, reinforced concrete, with 13 foot thick floors. The ground water table at the site is approximately 3,000 feet below the bottom of the silos. Total capacity of the site is approximately 1.5 million cubic feet. To date, just over five thousand cubic feet of disposal volume have been expended.[95]

Treatment provided prior to disposal is minimal. Bentonite clay is available to contain liquids and lime is used for pH adjustment if necessary. Additionally, a deodorizer is used to control noxious gas emissions when the silos are opened to receive incoming wastes. Vehicles used to transport materials to the site are inspected for contamination prior to release from the site. Equipment and procedures are available to decontaminate these vehicles in the event of a spill or container breakage.

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[95] Personal communication, Mr. Gene Rinebold, Wes Con, Inc., May 15, 1975.

TABLE VII-2

WASTES RECEIVED AT WES CON FOR THE PERIOD APRIL 1974 THROUGH AUGUST 1975[96]

Waste Type	Quantity
Drumed waste pesticide and pesticide manufacturing residues	2456 tons
Spent capacitor cells, sand and gravel contaminated with askeral transformer oil with trace PCB's	1407 tons
DDT*	4 tons
Fire damaged pesticides*	25 tons
Sweepings contaminated with pesticides	<1 ton
Waste Pesticide	<1 ton
Mercury treated seed	37 tons
Inorganic chemical waste	[illegible]2 tons
TOTAL	2726 tons

*Includes containers.

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[96] Wes Con Site Log, April 1974 to August 1975, received from U. S. Environmental Protection Agency, Region X Office, October 2, 1975.

Economics

User charges for the Wes Con site are typically negotiated on a case by case basis. The nominal quoted rate is $1.00 per cubic yard which, under present operating experiences, can be equated to $.0026 - $.0030 per pound. This price does not include shipment costs which are paid by the customer. The company would prefer to negotiate long-term contracts with prospective customers whereby the customer would purchase or reserve a given volume of disposal space for their own private use. Wes Con reports that to date no arrangements of this nature have been transacted;[95] hence, Wes Con continues to operate on a case by case basis.

Evaluation and Future Trends

Future plans for the Wes Con site call for the construction of an incineration facility which would allow for a significant volume reduction in the wastes requiring disposal and also permit the recycling of many of the metal drums received at the facility. Detoxification of a portion of the influent wastes through incineration would also allow Wes Con to use conventional landfill procedures for incinerator residues, thus realizing a further reduction in volume demand on the silos. Long-term commitments from industrial customers would provide the necessary financial security to permit capital expansion such as the incineration facility. To date these long-term commitments have not been forthcoming.

The Wes Con operation is viewed as an environmentally acceptable means of hazardous waste disposal. Wes Con's plans for a drum recycling facility are also considered commendable. Due to its relatively low overhead costs, Wes Con's disposal fees are quite competative; however, associated transportation costs from the main hazardous waste generating centers of the Willamette Valley and Seattle - Tacoma areas may continue to restrain the firm's growth.

RESOURCE RECOVERY, INC.
(WASTE DISPOSAL)

Background and Organization

Resource Recovery Corporation is a joint venture of Basin Disposal Company of Pasco, Washington, and Chemical Processors, Inc. of Seattle, Washington. The company was incorporated in the State of Washington in 1972 to operate an industrial waste management facility for purposes of collection, transporting, storage, processing, reclamation and recycling, and final disposal of wastes from industries in the Northwest. The firms only facility has since closed down due to the failure of the Franklin County commissioners to renew the firm's land use permit. Resource Recovery next attempted to establish a similar type operation (minus final disposal) at an abandoned Titan Missile Site near Warden in Grant County, Washington. Due to adverse public reaction to the proposed site, the Grant County commissioners have declined to issue a permit to Resource Recovery.[97] Resource Recovery is continuing its efforts to locate an industrial waste disposal site in Eastern Washington.[97] A brief discussion of the proposed Warden site operation is included below. It is expected that any future operation by Resource Recovery, Inc. would be similar in nature.

Waste Streams and Products

Resource Recovery proposed the initial handling of six general classifications of wastes at the Warden site.[98]

- Acid, base and salt solutions
- Caustic waste solutions
- Paint and resin wastes
- Metal finishing wastes
- Fertilizer manufacturing wastes
- Oily type wastes.

Resource Recovery intended to construct a series of evaporation ponds (described more fully in subsequent sections) to concentrate and dewater the aforementioned wastes. Recovery/recycling was planned for the following wastes:

- Caustic recovery for resale or use at the site to neutralize acid wastes.
- Metal recovery from acid, salt, and metal finishing sludges which accumulate in the evaporation basins.
- Processing of fertilizer wastes (a mixture of sodium carbonate and diisopropylene) to ammonia base fertilizer for resale back to the generator.

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[97] Personal communication, Mr. John R. Kimberly, President, Resource Recovery, Inc., October 22, 1975.

[98] Washington State Department of Ecology. "Draft Environmental Impact Statement - Proposal for the Establishment of an Industrial Waste Management Facility at Warden," by Resource Recovery Corporation of Seattle, Washington, April 1975.

Other wastes were to be dewatered and the remaining sludge removed for disposal. Although over one million cubic feet of abandoned missile silo space similar to the Wes Con facility is available at the Warden site, Resource Recovery did not, at the time, propose to use this space for disposal of non-reclaimable residuals. In part this is due to the fact that many of the silos have been fractured and have therefore lost some of their liner integrity.

Resource Recovery also planned to conduct a pesticide container washing and disposal operation at the site.

Waste Handling and Processing

Seven evaporation ponds ranging in size from 50' x 100' to 100' x 100' and 6' to 8' deep were proposed. All ponds were to be lined with plastic or bentonite clay (to prevent groundwater seepage) with the possible exception of the ponds used for processing resins and pigments. Experience at the Pasco site in Franklin County showed that these two types of materials are self-sealing in the bottom of the ponds.

Plans called for the periodic unloading of sludge from the pond using a front end loader. As indicated previously, certain sludges with no resource recovery potential would be disposed of as directed by the Washington DOE. Sludges containing recoverable metal would be transported to appropriate (although unidentified) recovery operations. The latter was one of the weak points in the proposed operation.

Economics

Disposal charges for the proposed Resource Recovery operation at Warden were not established; however, based on previous operating experience at Pasco, it can be expected that charges would be on the order of $0.50 per CWT for bulk liquids plus transportation costs.[99]

Evaluation and Future Trends

Failure of Resource Recovery to locate the proposed industrial waste disposal site in Grant County is viewed as a significant setback. Although the company intends to continue its search for an acceptable location, there appears to be no real prospects in the near future.[97] The company is maintaining some level of activity primarily in the form of transporting industrial wastes to the Chem Pro facilities in Seattle.[97]

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[99] Personal communication, John R. Kimberly, Resource Recovery, Inc., May 1975.

With respect to the proposed Warden operation, a comment relating to the resource recovery aspect is in order. The resource recovery aspects of the proposed operation remain ill defined in those areas relating to heavy metal recovery from the dewatered sludge and metal salt solutions. The economic and technical feasibilities of such an operation are unproven and in the final analysis will be heavily dependent on 1) the assay value of the predictably amorphous sludge; 2) the availability of applicable recovery technology; and 3) the current market price of the various metal constituents. Barring the suitability of the sludge for another use (e.g., fertilizer trace nutrient additive) a suitable means of ultimate disposal of this hazardous sludge would have to be found.

CROSBY AND OVERTON (WASTE REMOVAL)

This company (formerly Pac-Mar) directs its activities to ship sandblasting and tank cleaning. In the tank cleaning operations, a wide variety of hazardous wastes including: creosote; pentachlorphenol; solvents; oils; and solutions containing metal salts, acids, and caustics are collected. Most of the materials collected during tank cleaning operations are transferred to Western Processing or Chem Pro for reprocessing; however, Crosby and Overton does have a limited capability for oil separation, and does practice some recovery.[100]

The company maintains two facilities -- one on Swan Island in Portland, Oregon, and the other in Seattle, Washington. Wastes collected by the Portland operation are usually transferred to Chem Pro of Oregon while the Seattle wastes typically are handled by Western Processing or Chem Pro at Pier 91 on Elliot Bay. In 1972 this firm collected over 500,000 gallons of waste oil and solvents.[14] No site visit was made or business records reviewed to indicate if some wastes are taken to other operations or disposed of in an uncontrolled manner.

LIQUID WASTE DISPOSAL COMPANY (WASTE REMOVAL)

Located in Seattle, Liquid Waste Disposal Company (LIDCOA) provides portable containers to its customers for the collection of industrial wastes including oils, solvents, and liquid chemical wastes. These wastes are then transferred to either Western Processing Company or Chem Pro for reprocessing. Table VII-3 lists the receipts of wastes from LIDCOA at Western

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[100] Personal communication, Mr. Windsor, Crosby and Overton, Portland Office, June 4, 1975.

Processing for the period May 1974 through April 1975.* Data on transfers to Chem Pro were not available, however, LIDCOA has indicated that for the most part concentrated oil wastes are sent to Western Processing while oil wastes with higher water contents go to the Chem Pro oil separation facility at Pier 91 in Seattle. LIDCOA does maintain some permanent storage facilities at their East Marginal Way (Seattle) site for the temporary storage of liquid wastes; however, no treatment or recovery is practiced at this site.[101]

TABLE VII-3

DELIVERIES TO WESTERN PROCESSING FROM LIQUID WASTE DISPOSAL COMPANY (MAY 1974 - APRIL 1975)[102]

Material	Quantity
Oil	56,670 gal.
Acid-Caustic	41,147 gal.
Etching Solutions	21,690 gal.
Solvents	6,200 gal.
TOTAL	125,707 gal.

OTHER WASTE REMOVAL COMPANIES

During the course of the industrial waste survey, a number of small tank cleaning and septic tank companies were identified as receiving hazardous wastes. The types of wastes received by these operations include the following:

- Pentachlorophenol and creosote contaminated sludges and residuals from wood treating plants.
- Etching solutions from printed circuit board manufacturing.
- Cutting oils and solvents from a variety of operations.

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*Excluding December 1974 and January 1975.

[101] Personal communication, Mr. Jack Pinshev, Liquid Waste Disposal Company, August 15, 1975.

[102] Personal communication, Mr. R. S. Jorgensen, Solid Waste Management Branch, U. S. Environmental Protection Agency, Region X, June 16, 1975 (records of liquid waste receipts by Western Processing Company).

- Ink washings from ink manufacturing.

- Latex washings from paint manufacturing.

Information on the activities of small tank cleaning companies and septic tank companies remains incomplete. There are literally hundreds of these companies scattered throughout the region -- each one with the potential to handle hazardous liquid wastes. It would appear on the surface that the larger companies such as Liquid Waste Disposal and Crosby and Overton are aware of, and for the most part use the resources of companies like Chem Pro, Western Processing, and Wes Con; however, no such statement can be made with regard to the smaller companies. The potential problem of improper disposal of hazardous liquid wastes by hazardous waste generators that transfer their wastes to these smaller companies constitutes proper disposal. In most instances, the industries contacted would or could not identify the specific company which was receiving their waste. A total of ten waste removal companies (including Liquid Waste and Crosby and Overton) were identified by name. Of these ten, only five could be located. Aside from the two large companies previously discussed, one of the five companies contacted disclaimed the handling of any liquid wastes, another tank cleaner admitted that the PCP sludge he picked up from a wood treater had been buried on private property, and a third septic tank company said that the caustic and solvent wastes he was receiving were going to a local landfill.

Based on the limited information collected during the survey, the assumption that the consignment of hazardous wastes to waste removal companies constitutes proper disposal cannot be substantiated. Based on the few communications with waste removal companies which were located, and reports from Western Processing regarding inquiries (but no deliveries) by septic tank companies, it appears that questionable or improper disposal practices exist among some of these companies. The extent of such practices remains undetermined. This problem area underscores the need for better legislative authority and regulatory control. A permit program for sites and trip-ticket system for transfer of wastes as discussed in Chapter VIII could go a long way towards providing information which would allow the state to at least monitor potential problems if not control them. This is needed even for the major processors such as Chem Pro and Western Processing. At the present time, the state must rely on voluntary data. That is, an unacceptably weak position for a regulatory body to find itself in. Therefore, even though Region X is fortunate to have several active firms in the hazardous waste management area, management should not be considered adequate until mechanisms are available to obtain periodic reports and to allow spot checks on operations.

VIII. HAZARDOUS WASTE MANAGEMENT SYSTEMS

INTRODUCTION

An effective state or regional hazardous waste management system should include a "control mechanism". That is, control of some type is needed from the point of waste generation through handling and processing to the point of ultimate disposal. This control is best exercised through designated regulatory agencies empowered by specific legislation. Therefore, it is pertinent first to review the present activities of appropriate state and federal agencies, and the status of hazardous waste legislation and regulation in Region X; then to consider specific elements necessary to facilitate proper control of hazardous wastes.

STATE GOVERNMENT

State governments in all four states of the region are active in the area of hazardous waste management. In Oregon four separate pieces[14,103] of legislation have been enacted which deal totally or in part with hazardous waste management. This legislation includes:

- HB 1931 (1971 Legislature) -- An act that defines environmentally hazardous wastes (EHW) as radioactive materials, spent pesticide containers and other residues specified by the Oregon DEQ; Prohibits disposal of EHW's on land within the State except at designated sites; Sets procedures and requirements for EHW licensing; Delegates administrative and regulatory authority for hazardous waste management to the DEQ; and prescribes penalties for violation of the statutes. This legislation has been codified in Chapter 459 of the Oregion Revised Statutes (ORS) Sections 459.410 - 459.690 and 459.992.
- SB 77 (1973 Legislature) -- A law which revises portions of the language of ORS 459.410 - 459.690 and 459.992 but does not change the significant powers or duties of the State or other requirements of the Statutes.
- SB 293 (1973 Legislature) -- An act that provides additional authority to the DEQ to declassify hazardous wastes, to acquire disposal sites by condemnation

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[103] Personal communication from Patrick H. Wicks, Administrator of Hazardous Waste Management Division, Oregon Department of Environmental Quality, July 1975.

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procedures; and to use State Pollution Control Bond funds for hazardous waste disposal (emergency situations) and disposal site property acquisition. This bill also requires proper cleanup of hazardous material spills and barring action by the spiller authorized the DEQ to provide cleanup and to collect for incurred expenses.

- SB 163 (1975 Legislature) -- A statute which prohibits radioactive material disposal sites from being established, operated or licensed in Oregon prior to January 1, 1978; establishes standards for licensing radioactive waste disposal sites, and authorizes the Oregon Environmental Quality Commission to modify or waive any solid waste control law except those established under SB 163 if such actions are necessary to make the operation of certain disposal sites economically feasible provided that public health and safety will not be endangered.

Armed with this rather substantial backing, the Oregon Department of Environmental Quality has embarked on a number of projects in the area of hazardous waste management. This agency has recently complied a comprehensive study of hazardous waste management planning[14] which included an inventory of hazardous wastes and oil. The agency is also attempting to site a hazardous waste disposal facility in the state. Presently none are in existance. Efforts are also underway to finalize rules establishing requirements for EHW management, and prescribing criteria for the designation of EHW's.

Although Washington has no specific hazardous waste legislation, the Washington Department of Ecology (DOE) is active in hazardous waste management as part of the overall responsibilities delegated to them by the 1971 State Solid Waste Management Act. Past activities of the DOE have included an extensive solid waste survey of 500 Washington industries.[15] Hazardous wastes were identified in a number of instances during this 1973-74 survey. The DOE also provides technical assistance to local government and other state agencies on matters relating to hazardous waste handling and disposal. The location and certification of a hazardous waste disposal site in the State of Washington continues to be a major goal of the Solid Waste Division. Recent activities along these lines have included an effort to gain approval for the proposed Resource Recovery, Inc. site (see Chapter VII) near Warden in Grant County, and negotiations with state and federal agencies to find a suitable hazardous waste disposal site on public land.

Preliminary legislative efforts are also underway in Washington to explore the need for hazardous waste legislation similar to that which already exists in Oregon. Preliminary hearings by the House Ecology Committee have been conducted.

In Idaho, hazardous waste management is the responsibility of the Division of Environment, Department of Health and Welfare (DHW). Like Washington, the DHW has conducted a state solid waste survey which included identification of hazardous waste sources.[13] The department operates under the Idaho Solid Waste Management Regulations and Standards and controls hazardous waste disposal through the issuance of conditional use permits for various public and private landfill operations. One site (Wes Con, see Chapter VII) has been approved for pesticide containers and hazardous waste disposal. Efforts to locate and approve landfills throughout the state for triple-rinsed pesticide containers disposal are presently underway. Presently, no hazardous waste legislation is planned.

The State of Alaska has no specific legislation related to hazardous wastes in general, and no pending or new legislation upcoming. No regulations on pesticide containers are anticipated either. The Department of Environmental Conservation (DEC), which oversees these activities, sites a lack of sufficient pesticide use as the major reason for no present regulation. Growing use patterns along the pipeline may change this.[104]

The State of Alaska is concerned about the potential growth of hazardous waste quantities which may result from the rapidly expanding activities of the petroleum industry. Consequently, a hazardous waste disposal site is being evaluated for drilling needs, chemical solvents, and other wastes. Most of these materials will go to land disposal. Currently, a site for oily wastes on the Kenai Peninsula, 60 miles southwest of Anchorage, is being developed. The site will be operated by the Kenai Peninsula Borough under a permit from the DEC.[104]

A state inventory of production of potentially hazardous wastes is planned for 1976.[104]

FEDERAL GOVERNMENT

The Environmental Protection Agency, Region X office located in Seattle, Washington is active in hazardous waste management through its Solid Waste Management Program. Approximately half a man year per year is devoted towards providing technical assistance to state and local governments. This assistance is provided through:

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[104] Personal communication, Mr. Lance G. Elphic, Alaska Department of Environmental Conservation, August 20, 1975.

- technical review of hazardous waste regulations, handling and disposal practices;
- consultation relating to political considerations, and upgrading of present practices;
- implementing federal guidelines on disposal of pesticide containers;
- dissemination of relevant information and publications; and
- awarding of EPA contracts and preparation of in-house reports.

The EPA also works with federal agencies to recommend proper handling and disposal options for their hazardous wastes. Coordination of regional approaches to hazardous waste management in another area of interest.

HAZARDOUS WASTE DISPOSAL

Various sections of this report have touched upon the problem of hazardous waste disposal. Results reported in Chapter V indicate that potentially hazardous industrial wastes of necessity are being disposed of on private property and in public landfills throughout the region despite the fact that these sites have not been formally designated as hazardous waste disposal sites. Indeed, only one site in the entire region, the Wes Con site near Grandview, Idaho, has been officially approved for hazardous waste disposal. Other sites presently receiving what have been classified here as potentially hazardous wastes are in some instances accepting these wastes with the approval of local authorities. Such approval is usually granted on a case by case basis and although preferable to promiscuous dumping, is not viewed as the best long-term solution to hazardous waste management. Indeed, barring recycle and reclaimation of hazardous waste, the best disposal option is one whereby the wastes are deposited in a secured area where long-term custodianship of the waste is assured and where there is no danger to the surrounding environment.

Sites which meet these requirements have been identified by both state and federal agencies. Table VIII-1 lists sites which were identified in a preliminary assessment by the Washington Department of Ecology in their state.[105] Also

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[105] Personal communication, Mr. Tom Cook, Washington Department of Ecology, August 1975.

TABLE VIII -1

ACCEPTABLE HAZARDOUS WASTE DISPOSAL SITE LOCATIONS

Sites Identified by the Washington DOE[105]	States Identified in the EPA National Hazardous Waste Management Study*,[1]
Franklin County (14 sites)	Franklin County, WA
Whitman County (1 site)	Benton County, WA
Walla Walla County (1 site)	Whitman County, WA
Adams County (4 sites)	Malheur County, OR
Benton County (1 site)	Lincoln County, WA
	Adams County, WA
	Walla Walla County, WA
	Grant County, WA
	Sherman County, OR
	Gilliam County, OR
	Harney County, OR
	Deschutes County, OR
	Douglas County, WA
	Morrow County, OR
	Columbia County, WA
	Umatilla County, OR
	Kittitas County, WA
	Klickitat County, WA
	Payette County, ID
	Spokane County, WA
	Latah County, ID

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*Top twenty-one on priority ranking for Oregon, Washington, and Idaho.

shown in the table are counties in the State of Oregon, Idaho, and Washington which were identified as being the most suitable for hazardous waste disposal in a recently completed EPA study on National Hazardous Waste Management.[1] The counties were selected by a computer program which considered a variety of physical/chemical, ecological, transportation, and human resources factors to arrive at a prioritized ranking of counties within the three states which were most suitable for the location of a hazardous waste disposal site.

The sites identified by the Department of Ecology as well as those in the EPA study were chosen on a technical basis. That is, such factors as land availability, location, climatic conditions, hydrology, and geology along with other intrinsic characteristics of the site were evaluated to identify the environmentally acceptable sites. Experience has shown that such selection criteria, although seemingly quite rational, do not always lead to the successful siting of a hazardous waste disposal facility. For example, local opposition in Franklin County, Washington, rated highest in the region by the EPA study, lead to the closure of the Resource Recovery, Inc. operation near Pasco. Efforts by the same firm to establish a new site in Grant County, Washington, also considered a priority site, were met with heavy local opposition. Efforts by Chem Nuclear, Inc. to establish a radioactive and hazardous waste disposal site at Arlington in Gilliam County, Oregon, were also recently rejected. Thus, despite the apparent technical acceptability of all three of these sites, local opposition seems to weigh more heavily. In short, no one wants hazardous wastes dumped in their own backyard. Land disposal is still the most economical alternative for many hazardous wastes. Indeed, for some hazardous wastes, land disposal is the only currently viable option (i. e., arsenic wastes). The Wes Con site has a large capacity, but its location requires transportation costs and spill risks which tend to discourage its use by producers in the Seattle and Willamette Valley areas. Several industrial representatives presently using Wes Con noted that at the present time, the bulk of their disposal costs are associated with transportation to Wes Con. A closer, more central site would both reduce these costs and cut the spill risk associated with long hauls of hazardous wastes.

At the same time, if private enterprise is expected to own and operate sites, only a few sites can be sustained in Region X. There is not a sufficient waste volume at this time to support multiple sites throughout the region. This contention is strongly supported by management at Wes Con as well as several national firms who have reviewed the market potential for branch operations. Discussions with management at Chem-

Trol[106] in Model City, New York suggest that disposals of 20,000 tons of waste per year are required to support a viable disposal business if secured landfill is the sole operational activity. Under this assumption, Region X can presently support up to five* sites if they are to be owned and operated by private enterprise. Fewer sites with sufficient capacity can satisfy the need. As noted earlier, the Wes Con site is a major part of the total requirement for hazardous waste disposal, but a second more central site is desirable to provide lower disposal costs (costs would be lower as a result of transportation distances) and to reduce spill risks.

The problem of which sites are optimal remains. Ideally, one selects the site best suited for such an operation. From an environmental standpoint, there are many sites in the region which are acceptable as illustrated by the listing in Table VIII-1. The next consideration is, proximity of the site to major waste sources and the commensurate reduction in transportation risks which can be achieved. If, for instance, transportation at a distance greater than a "critical" distance is deemed to pose an unacceptable risk then sites should be selected in areas within the circle described by that threshold radius from the source locations. To date, however, hazardous wastes have not been identified which pose a transportation risk great enough to describe such a radius. Indeed, researchers at Arthur D. Little, Inc.[107] found that transportation of hazardous wastes up to 1,000 miles did not pose unacceptable risks. The highest transportation risks are those associated with injury or property damage resulting from fire, explosion, or the release of toxic gases. Materials with these properties are treated in some manner other than burial at a disposal site, such as incineration or chemical destruction. Thus, the potentially hazardous wastes in Region X, suitable for land disposal at certified sites, do not pose high enough transportation risks to make this consideration a limiting factor.

Consequently, economics becomes the controlling factor with respect to transportation of hazardous wastes. The question arises; are additional disposal sites required to make proper disposal economically attractive in Region X. As noted earlier, it would appear that at least one more site is needed for this very reason. At the present time, transportation costs to the Wes Con site often exceed disposal cost and this situation has encouraged some industries to store wastes (see Table V-1) until a lower cost option is available.

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*Based on a maximum waste volume of 113,833 tons after reclaimed or recycled wastes are subtracted from the total in Table V-2.

[106] Personal communication, E. R. Shuster, Division Manager Chem-Trol, Pollution Services, Inc. November 11, 1975.

[107] Arthur D. Little. "Alternatives to the Management of Hazardous Wastes at National Disposal Sites," (Draft) U. S. Environmental Protection Agency, January 19, 1972.

One approach that can be taken to select optimal sites from an economic standpoint has been described by Arthur D. Little, Inc.[107] It is based on a tradeoff between having on-site treatment and a centralized treatment facility. An economic decision map is constructed under the assumption that sources are evenly distributed about a grid. Based on economic tradeoffs, one can then calculate the area that a central plant can economically serve.

To apply this type of approach to Region X where generation sites are clustered about major metropolitan areas, one can treat each city as a source and determine the maximum acceptable distance from each city at which a disposal site could achieve economical off-site treatment of hazardous wastes. Using the data provided by Arthur D. Little, Inc.[107] specific radii for different waste type and quantity combinations can be calculated. The minimum radii for key counties in Region X are plotted on a regional map in Figure VIII-1. The plot assumes that all wastes are routed to the disposal site. If wastes that are presently recycled or processed for recovery are subtracted out, the appropriate radii become larger; however, the radii will not be sufficiently large to encompass the Wes Con site for all wastes.

From Figure VIII-1, it is clear that all wastes could economically be routed to Grant, Adams, Benton, and Franklin Counties in Washington; and Sherman and Gilliam Counties in Oregon. All the counties are served by rail, and highway transportation. Grant and Franklin Counties have rejected bids for sites recently. Gilliam has rejected a radioactive waste disposal site, but may accept an industrial waste site. Hence, the optimal site will be somewhere in Adams, Benton, Gilliam, or Sherman Counties. Benton County may be particularly attractive because of the potential to incorporate with the Hanford Atomic Reservation. This would insure certain safety aspects due to the large buffer zone surrounding the area and could satisfy some concerns over guardianship in perpetuity. In this regard, Benton County has to be considered the first choice of the three if federal lands can be obtained. If not, either of the two adjacent Oregon counties or Adams County would be acceptable.

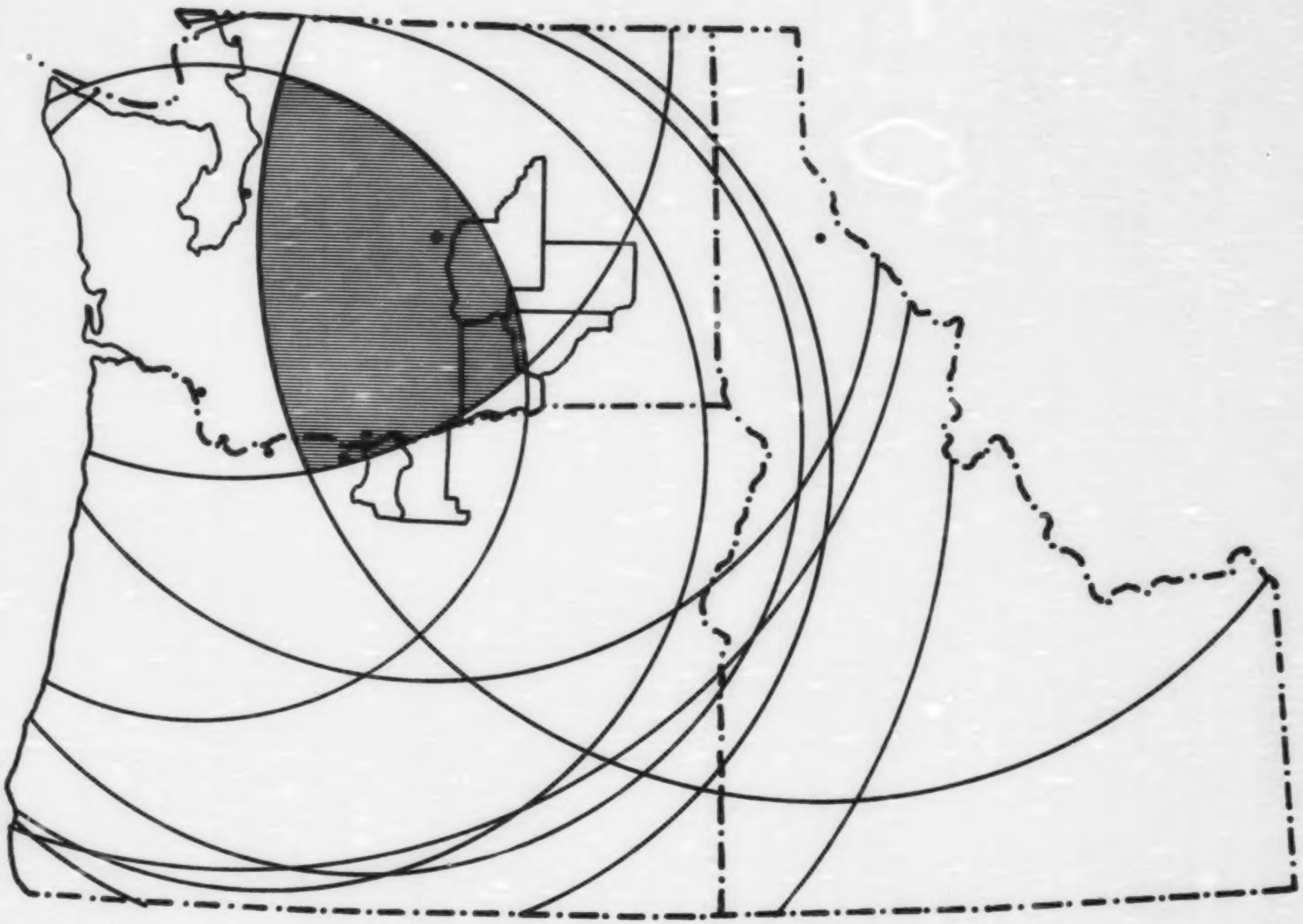

FIGURE VIII-1. OPTIMUM ECONOMIC ZONE FOR LOCATION OF HAZARDOUS WASTE DISPOSAL SITES.

REGULATORY CONSIDERATIONS

In addition to siting hazardous waste facilities, proper hazardous waste management requires the development of a strong regulatory program. The latter is possible only if legislation is flexible enough to facilitate it. At the present time, Oregon is the only state in Region X armed with sufficient legislative authority to properly address hazardous waste management. The remaining states have only the rudiments of the type of authority required. The discussion that follows is designed to highlight some of the considerations that should be taken in developing regulations and in so doing, indicate the kind of legislative breadth that is desirable.

Much of the discussion thus far has focused on the point of generation and point of disposal for hazardous wastes. Since the two are often not coincident, it is evident that the transportation sector plays an important role in the hazardous waste management system. Unfortuantely, however, this sector has historically neglected wastes while focusing on pure commodities.* This is true at both the federal and state levels. At the present time, none of the states in Region X have in place regulations which deal with the transportation of hazardous wastes. Hence, these materials often move throughout the states in unsuited containers with improper or no placarding. Haulers are not specifically licensed and so there is no means of telling where they take the wastes or when they discharge them. Further more, bills of lading contain insufficient information to aid in emergency situations or to provide receiving agents with an adequate description of what they are getting.

The current status of federal regulations does not improve upon this. Indeed, at the present time, the latest placarding system has been abandoned and alternates are being reviewed. None of these address hazardous wastes per se. Re-introduction of any system similar to previously recommended ones will still leave some materials classed as hazardous wastes -- unclassified, or not otherwise specified. The DOT Office of Hazardous Materials Policy has suggested that this situation may change with the new Hazardous Materials Transportation Act signed into law in January 1975. It is their opinion that this piece of legislation gives them the authority to specifically address hazardous wastes for all carriers, not just interstate carriers. They further have been given authority to prempt state laws where the latter are found inadequate or incompatible with federal regulations.

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*Transportation in most cases refers specifically to trucking. Rail has been suggested as a competition for hazardous waste shipment, but competition has not surfaced to date. This may reflect the fact that tank cars are often dedicated to service and hence, not available for liquid or slurry wastes while general tank trucks are. It also reflects the fact that trucks are more flexible with respect to routing. This predominance of trucks is also good from a risk standpoint. Present estimates[108] suggest that truck shipments threaten 1/2 to 1/4 of the spill incidents threatened by rail. If rail maintenance continues to deteriorate, this gap may widen.

[108] Authur D. Little, Inc. "A Model Economic and Safety Analysis of the Transportation of Hazardous Substances in Bulk," prepared for U. S. Department of Commerce, Maritime Administration, July 1974.

It is doubtful that such broad powers actually reside with the DOT. Indeed, current commentary by trade associations, state authorities, and other federal agencies hold that the DOT will most likely end up with regulatory authority over only interstate carriers and those interstate carriers which use the federal highway system. This will still leave a gap for the uncontrolled and unreported transport of wastes. It also includes no provisions for transmittal of bills of lading both at the initiation and completion of the transportation activity. Thus, the state(s) has no information base on the amount of specific wastes being transported, or their actual destination.

Several states outside of Region X have determined this deficiency to be a major weakness in the hazardous waste management system. To compensate for this, states such as California and Texas have instituted a "manifest" or "trip ticket" system. An example of the latter is illustrated in Figure VIII-2.

The generator of the waste or the agent discarding a waste fills out and signs a trip ticket upon delivery to the transporter. The transporter also signs the ticket verifying delivery. The ticket includes the name of the generator, the transporter, the intended destination, and a description of the waste including approximate concentrations of specific constituents and quantity. When the waste is transfered to the transporter, copy No. 1 of the trip ticket is placed in the generators records. Copies No. 2, 3, and 4 are given to the transporter. During transport, any over-the-road inspection should find a one-to-one correlation between the load and the trip ticket on hand. Upon delivery of the waste to an approved disposal site, the transporter signs the ticket again to verify delivery as does the disposal site operator to verify receipt. The transporter retains copy No. 2 for his records while copies No. 3 and 4 are transferred to the disposal site operator. The operator in turn sends Copy No. 3 to the generator to verify delivery at an approved site while copy No. 4 is retained for the disposer's records.

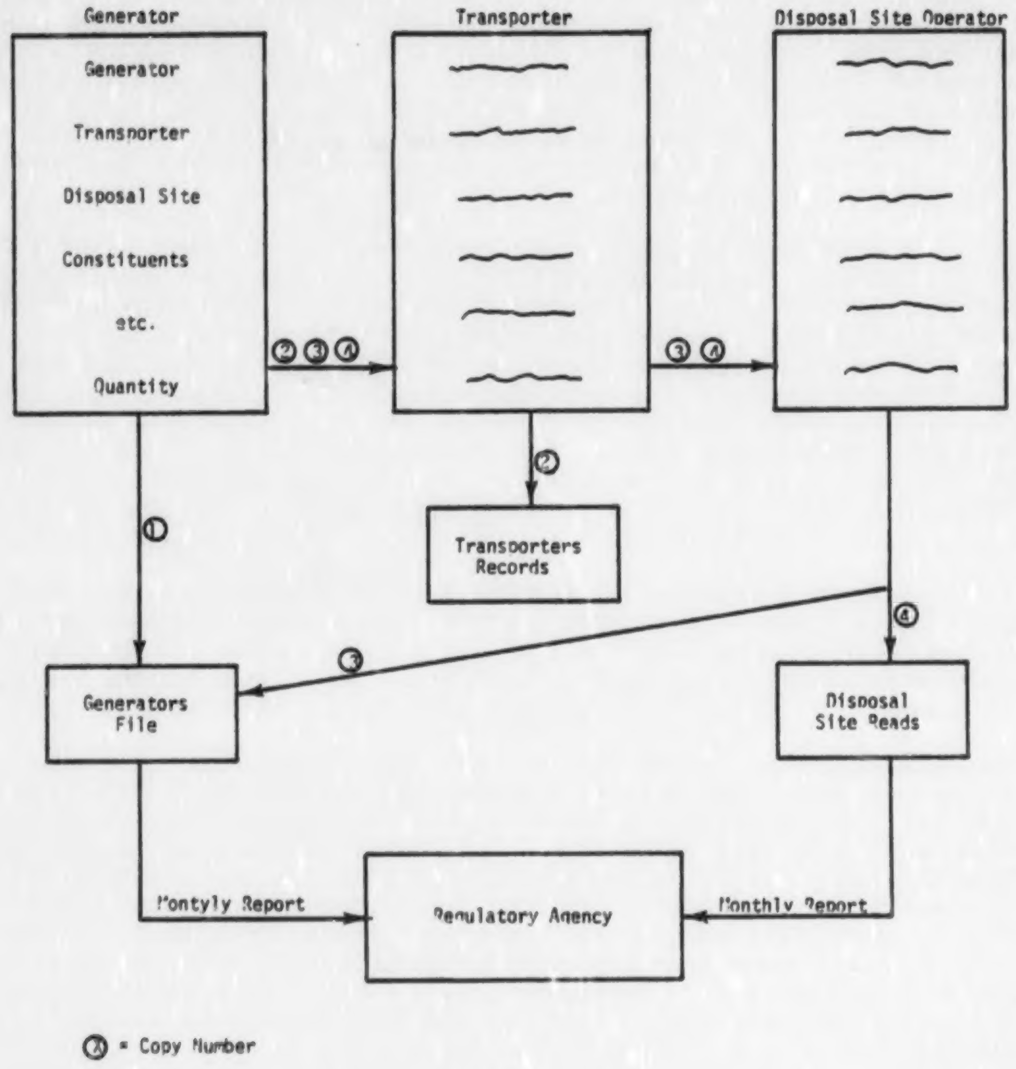
Generator
Transporter
Disposal Site Operator
Generator
Transporter
Disposal Site
Constituents
etc.
Quantity
② ③ ④
③ ④
②
Transporters Records
①
④
③
Generators File
Disposal Site Reads
Montyly Report
Regulatory Agency
Monthly Report
④ = Copy Number

FIGURE VIII-2. PROCEDURES FOR HAZARDOUS WASTES TRIP TICKET (SCHEMATIC)

Both the generator and the disposer subsequently must tabulate the data from their files and provide monthly summaries of hazardous waste activities to the regulatory agency. California is presently automating the information system to facilitate use of this data. Intended uses include the comparison of quantities shipped and delivered to discover or prevent loads being dumped indescriminately at unapproved sites and the maintenance of an inventory of data on waste quantities received at specific sites. The latter will help in estimating facility life as well as checking compliance with disposal permit regulations authorizing disposal of specific waste types at specific site types.

Texas has yet to implement the system described. California's system is operable save the automated analysis center. To date, officials are happy with results and feel the system is one of the more easily implemented options available. A few additions have been made. Farmers hauling empty pesticide containers or undesired residuals are asked to complete tickets when they arrive at a disposal site. All liquid haulers have been required to obtain specific permits for hauling liquid wastes. There is some dismay that the permits are not required of all haulers since solid hazardous wastes are not presently covered.

The institution of a trip ticket system does not provide for the reporting of wastes disposed of or stored indefinitely on-site by the generator. This situation calls for additional information mechanisms. The importance of the latter cannot be over emphasized. Without mechanisms for mandatory reporting, the state simply cannot get a firm grasp on the actual status of hazardous waste management in its jurisdiction. This leads to reliance on voluntary compliance with requests such as that conducted for this program. This is a weak position for a state to find itself in since it relies on the good faith of those most affected by proposed regulations.

This raises the question of whether or not hazardous waste legislation and subsequent regulations are needed. At the present time, there are comprehensive controls being placed on discharges to the air and water. This places a tremendous burden on the land as the final receptical of residuals. Without balanced legislation to protect the land environment, continued abuse is unavoidable. At the same time, it must be recognized that hazardous waste legislation does not provide the total protection desired. Indeed, hazardous waste legislation should be viewed as a necessary addendum to a more comprehensive land disposal program, not a surrogate. Within this context all four states in Region X should be encouraged to develop and enact strong, rationale pieces of legislation addressing hazardous waste management.

Additionally, because of the economies of scale and existence of commerce that transcends state boundaries it should be recognized that uniform or generally compatible regulations in adjoining states are highly desirable. Similar efforts are underway in other parts of the nation with regard to air pollution regulations. There is no reason to believe that workable forums cannot evolve for hazardous waste management. This is developed more fully in the following section.

Any discussion of interstate cooperation must touch on state bans against the importation of wastes. Several states, such as New Jersey, have already instituted such restrictions. From a regional management standpoint, this is undesirable. From a legal standpoint, it may soon be an unavailable option. The New Jersey Supreme Court has overturned to uphold the New Jersey ban. If the Supreme Court determines that with bans on interstate importation are an interference with interstate commerce and, therefore, unconstitutional, this decision will be overturned.[109] Barring such an outcome, the states of Region X should encourage provisions specifically prohibiting such importation bans.

Recent experience in Franklin and Grant Counties suggest that siting may be a major stumbling block to development of a comprehensive hazardous waste management system. This raises several issues. Primarily, it suggests that any legislation enacted to regulate the disposal of wastes must avoid prescribing tight time frames for compliance. It would be naive to assume that adequate disposal facilities will be available soon after enactment. Recent experience, both in Region X and elsewhere in the U. S., suggest that upwards of three years may be required to develop the facilities required once legislation provides private enterprise with the incentive to expand the present hazardous waste processing and disposal industry. Recognizing this, some states have begun to consider the desirability of having the authority to invoke eminent domain if county political groups deny use of otherwise acceptable sites. This is a harsh measure which should be considered carefully before taken. Past episodes in Texas where county and local perogatives have been pre-empted created a sufficiently hostile environment that the applicant organization ultimately withdrew.[110] While states may wish to place provisions for eminent domain in their legislation, it should be considered only as a last resort.

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[109] Solid Waste Report, Volume 6, No. 24, p. 239, November 24, 1975.

[110] Personal communication, Mr. Ray Barber, Brouning Ferris, Inc., October 2, 1975.

Because of the highly technical and political nature of hazardous waste management, there is a growing concern that an outside advisory body is needed to make recommendations and review agency actions. The latter can include a number of options. In essence, however, it is a committee appointed for specified terms from the various sectors of involvement including the disposal industry, the generating industries, and the public. This committee meets on an as needed basis to review proposed regulations and make recommendations on subsequent action. Typically, the agency is not obligated to follow recommendations. In general, there has been concern that such an arrangement gives the advisory group no clout and, therefore, undermines its value. Experience in California, however, reveals that even without strong authority, committee recommendations are not taken lightly.

Should a strong regulatory program be developed, there are may configurations available. One that appears to provide comprehensive coverage as well as a simple logic is illustrated in Figure VIII-3.

A hazardous waste is first evaluated to determine if an exemption is warranted. The latter is granted if special circumstances or conditions dictate. An exemption allows the disposal of specified wastes in non-permitted sites. That is, the waste is allowed to be disposed of in sanitary or other landfills where hazardous wastes are not normally allowed. If an exemption is not warranted, it is next necessary to determine if it is a waste allowed in designated hazardous wastes disposal sites. If so, it is directed to a designated site. If the waste is not in a form acceptable at hazardous waste disposal sites, it must be further processed. At this point, the processor can consider recycle or resue options. This part of the evaluation need not be included in the regulatory structure. If the processed waste or its residual is still potentially hazardous, it is once again subjected to the regulatory logic.

While the process detailed above is simple in nature, it provides for two important features of a regulatory program: 1) the granting of exemptions, and 2) the establishment of a permit program. Exemption may be granted for any non-hazardous waste as well as hazardous wastes in special circumstances. The permit program should encompass all sites at which hazardous wastes are disposed. It provides for control both in the operation and in the ultimate decommissioning of sites such that environmental hazards are minimized. At a

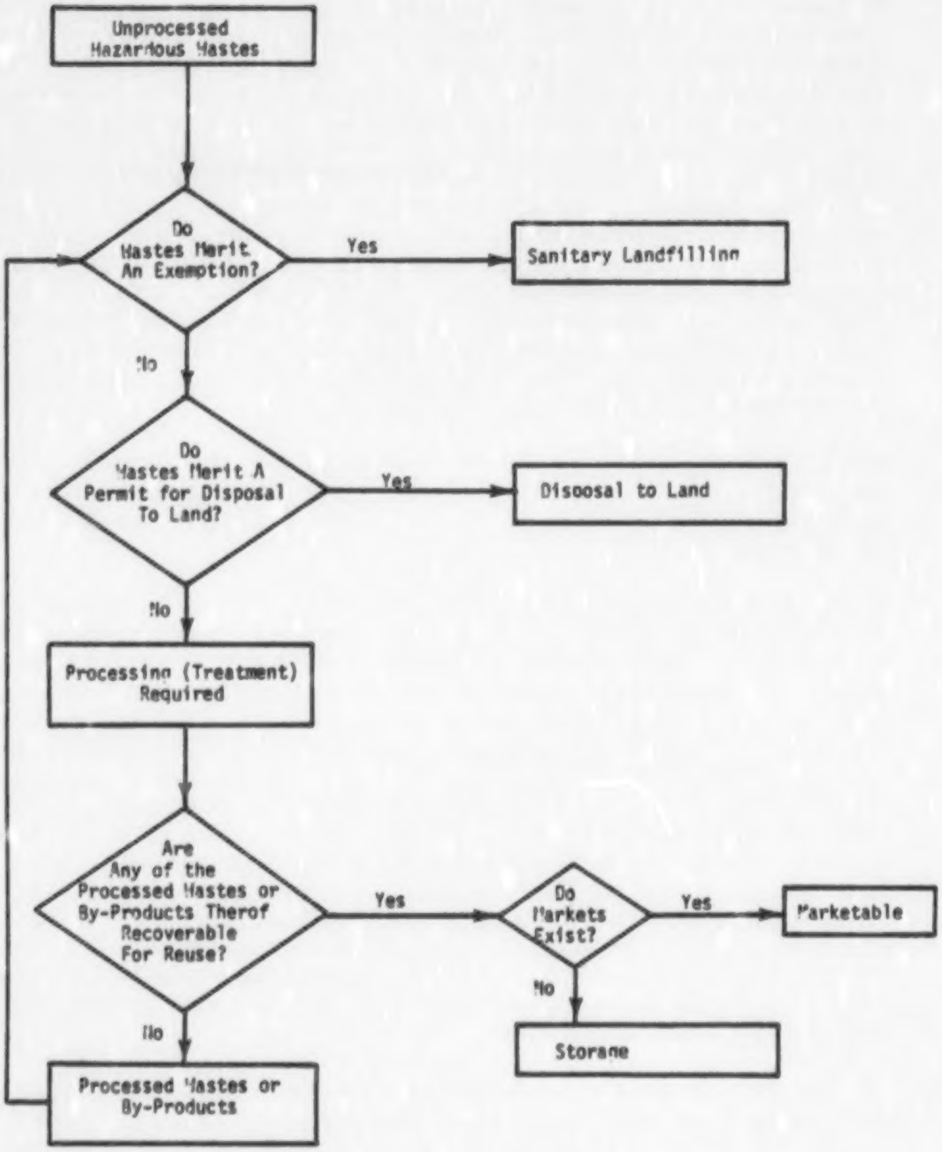
Unprocessed Hazardous Wastes
Do Wastes Merit An Exemption?
Yes
Sanitary Landfilling
No
Do Wastes Merit A Permit for Disposal To Land?
Yes
Disposal to Land
No
Processing (Treatment) Required
Are Any of the Processed Wastes or By-Products Therof Recoverable For Reuse?
Yes
Do Markets Exist?
Yes
Marketable
No
Storage
No
Processed Wastes or By-Products

FIGURE VIII-3. LOGIC DIAGRAM FOR REGULATORY CLASSIFICATION OF HAZARDOUS WASTES

minimum, the permits provide recorded information on the location of sites where potentially long-lived hazards are being placed. This should greatly reduce the cases where incidental exposure after abondonment causes damage.

COOPERATIVE CONCEPTS

While hazardous waste management comes under the control of individual state regulatory programs, it is apparent that problems and potential solutions are common throughout the region. Furthermore, optimal management will often require the crossing of state boundaries to facilitate waste processing and to realize economies of scale. Recognizing this, several comments are in order with respect to cooperation among the parties involved.

The proper and cost effective management of hazardous wastes relies on a knowledgeable, competitive, and active waste handling industry. Included in the latter are waste haulers, processors, and disposal site operators. Many times, economics require that these organizations operate in multi-state areas. Further, logical market areas may be dictated more by topographic and transportation considerations, than political boundaries. The latter realities can frustrate growth of the industry if each state maintains programs vastly different in content and execution. Proliferation of incompatible regulatory definitions of hazardous wastes, manifests, transportation restrictions, permit requirements, and siting criteria increase operating costs. This discourages expansion to interstate marketing and encourages generators to cut costs by undertaking unacceptable disposal options.

To avoid the above mentioned events, states in Region X, and especially Oregon, Washington, and Idaho should make a major effort to coordinate regulatory efforts while the latter are in the formative stages. Interaction between pertinent agencies should be encouraged in an attempt to develop mutually acceptable approaches to management control alternatives. Of particular importance are compatible definitions of hazardous wastes, permit requirements, transportation regulations, and manifests. Early attention to these will circumvent tendencies to move wastes into the more lenient states regardless of economic and environmental factors.

Information flow also appears to be an area where cooperation could be very rewarding. During the study reported here, it became quite apparent that many waste generators, both large and small, public and private, are unaware of the alternatives available to them for disposal of hazardous wastes. This can be particularly unfortunate if a market exists for these wastes as input to other processes. The questions arising from this reality suggest that a central information function could be very beneficial.

At the present time, the regional EPA office is best suited to provide this resource. Several major operational modes can be envisioned. These include:

- Function as a waste exchange information center to facilitate matching process input needs to existing wastes.
- Disseminate information of existing waste processing operations which can be utilized.
- Provide data on waste disposal technology available for on-site use.
- Distribute information on hazards and safety procedures pertinent to waste management.
- Identify specific areas and wastes where new technology is needed.

The regional office presently does not have the capability to perform many of these services because of staff and budget levels. Currently, two individuals are charged with responsibility for all solid and hazardous waste activities in the region. This is an insufficient base from which to conduct the desired activities. At the same time, it should be noted that people are not utilizing the resource that does exist. Interviews with generators suggest that much of this is due to a lack of knowledge that the resource exists and that regulatory staff can assist them without imposing burdensome costs or requirements. From this, one can assume that a general public relations effort is in order. An effort must be made to remove lack of information as a major reason for improper or sub-optimal waste management.

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APPENDIX A

DESIGNATION OF AND DETERMINATION OF REMOVABILITY FOR HAZARDOUS SUBSTANCES

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ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 116]

[FRL 252-6]

HAZARDOUS SUBSTANCES

Designation of and Determination of Removability

The Environmental Protection Agency, is hereby giving advance notice of intent to create a new Part 116 of Title 40 of the Code of Federal Regulations pursuant to the authority contained in sections 311(b)(2)(A) and 311(b)(2)(B)(i) of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251 et seq. (the Act)).

Section 311(b)(2)(A) of the Act provides as follows:

> The Administrator shall develop, promulgate and revise as may be appropriate, regulations designating as hazardous substances, other than oil as defined in this Section, such elements and compounds which, when discharged in any quantity into or upon the navigable waters of the United States or adjoining shorelines or the waters of the contiguous zone, present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches.

Section 311(b)(2)(B)(i) of the Act states:

> The Administrator shall include in any designation under subparagraph (A) of this Subsection a determination whether any such designated hazardous substance can actually be removed."

In order to effectively address the problem of chemical spills and assess the impact on affected parties, this advance notice of proposed rulemaking is being issued to solicit public comment on the tentative criteria for selection of hazardous substances, the substances under consideration, and the determination of actual removability of those substances. Because much of the information desired prior to proposed rulemaking exists only in the private sector. information on actual or potential spills of substances, as well as current measures for spill prevention and the effectiveness of such measures, is especially requested.

Under Section 311(b)(2)(A), hazardous substances are limited to materials other than oil as defined in section 311(a)(1). In identifying substances which may be designated as hazardous substances for purposes of section 311 of the Act, it was recognized that virtually every substance has the potential for presenting some danger to public health or welfare depending upon the quantity of the substance discharged, and the time, location, and conditions of the discharge. For example, the permitted use of an aquatic herbicide in accordance with an Environmental Protection Agency registration is not considered a hazardous substance discharge to be regulated by section 311. Additionally, the chemical aluminum sulfate (alum) is commonly used in food and drinking water processing. In these uses and quantities, alum is obviously not a hazard to the public health and welfare. However, the release of these same materials in large quantities from a storage tank, manufacturing plant or transportation source may create a substantial danger to aquatic life. Thus, the materials listed herein are under consideration because of their harmful effects when released into the aquatic environment in spill situations.

In analyzing the extremely large number of substances which could be designated hazardous within the meaning of section 311, the Agency is considering several factors. These factors deal with quantities produced and handled, effects on life forms and the potential for spillage of each of the substances. It is therefore suggested that substances which can reasonably be anticipated to present an imminent and substantial danger to public health and welfare, would be selected using the following criteria:

1. Any element or compound produced in excess of research quantities possesses sufficient danger potential to be considered as a candidate hazardous substance if it is lethal to: (a) One-half of a test population of aquatic animals in 96 hours or less at a concentration of 500 milligrams per liter (mg/l) or less; or (b) one-half of a test population of animals in 14 days or less when administered as a single oral dose equal to or less than 50 milligrams per kilogram (mg/kg) of body weight; or (c) one-half of a test population of animals in 14 days or less when dermally exposed to an amount equal to or less than 200 mg/kg body weight for 24 hours; or (d) one-half of a test population of animals in 14 days or less when exposed to a vapor concentration equal to or less than 200 cubic centimeters per cubic meter (volume/volume) in air for one hour; or (e) aquatic flora as measured by a 50 percent decrease in cell count, biomass, or photosynthetic ability in 14 days or less at concentrations equal to or less than 100 mg/l.

2. To be further considered for designation as a hazardous substance, any element or compound meeting the above criteria must have a reasonable potential for being discharged; i.e., spilled into a water body. Factors being considered in making this evaluation include the production quantities, modes of transportation, handling and storing practices, past spill experience, and physical-chemical properties of each substance.

To satisfy the requirement of section 311(b)(2)(B)(i), the Agency is considering the determination of actual removability from the water of each candidate substance. Factors under study in making this determination include the substance's solubility, density, physical state, dispersion characteristics, aquatic stress potential such as acute lethality, potential for leaving a residue, and detectability in the water body, as well as the current status of removal technology and availability of necessary equipment. Based upon these factors, the Agency is considering the determination that all of the substances listed in this advance notice of proposed rulemaking are not actually removable.

In this respect it should be noted that section 311(a)(8) contains a definition of "remove" or "removal". The definition has two elements: (1) "Removal of the oil or hazardous substances from the water and shorelines"; and (2) "the taking of such other actions as may be necessary to minimize or mitigate damage to the public health or welfare". The phrase "actually be removed" as used in section 311(b)(2)(B)(i) is considered to refer only to the first element of this definition. In other words, if the spilled substance cannot normally be removed from a water body by physical, chemical or biological means, then it would not be "actually removable" for purposes of the eventual hazardous substance designation. The fact that some other action may be possible to "minimize or mitigate damage to the public health or welfare"—does not make the substance "actually removable" for purposes of hazardous substance designation. However, actions taken under the second element of the definition in section 311(a)(8)—i.e., actions taken to minimize or mitigate damage but which do not result in actual removal—may qualify for reimbursement from the revolving fund under section 311(c) and may result in liability of the discharger under the conditions specified in section 311(f).

Should final rulemaking determine that a substance is not actually removable, discharges of that substance may be subject to civil penalties imposed by section 311(b)(2)(B)(ii) and (iii). Discharges of harmful quantities (to be established by regulations pursuant to section 311(b)(4) of the Act) of a designated hazardous substance shall be subject to the notification requirement of section 311(b)(5) and civil penalties imposed by section 311(b)(6).

It is important to note that not all discharges of substances designated as hazardous will be subject to the enforcement provisions of section 311. Because section 311 applies only to discharges from vessels or facilities, a designation regulation would not apply to discharges from other sources such as agricultural land runoff, or irrigation return flows. The discharges being considered can be placed in two separate categories. The first relates to transportation and storage incidents in which there is normally no release of the substance except in the spill situation. The second relates to industrial production facilities in which a designated hazardous substance is released in quantities exceeding those of a permitted normally operating effluent. Periodic or continuous discharges are regulated under other provisions of the Act. Accordingly, the Agency is considering that the regulation would exclude from designation discharges of hazardour substances which are made: (a) In compliance with effluent limitations or guidelines established under sections 301, 302, 304, 306, and 307, of the Act; (b) in quantities not exceeding those identified for such substances in an application for an NPDES permit which has been issued pursuant to section 402 of the Act; (c) in compliance with permits

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issued under section 404 of the Act or sections 102 and 103 of the Marine Protection, Research Sanctuaries Act of 1972 (33 U.S.C. 1401 et seq.); (d) from properly functioning marine sanitation flow-through devices certified by the United States Coast Guard pursuant to section 312 of the Act; or (e) in the course of a permitted use of a pesticide registered under the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. sections 136 and through 136y).

Utilizing the above criteria, the Agency has made an initial assessment that the substances listed below should be included in the list of hazardous substances. Because of the many materials involved and the complexity of the review and decisions which have to be made, the Agency has determined that the most appropriate action is to solicit comments on this list as presently constituted through this advance notice. This is being done with a view toward obtaining detailed comments and data which are relevant to the subsequent rulemaking action. The Agency is interested in suggestions based upon fact for additions to and deletions from the list as well as comments on the appropriateness and levels of the selection criteria. In addition, the Agency is interested in comments about whether the general magnitude of the list is commensurate with the problem to be dealt with and the intent of the statute. The specific criteria used for selection of each substance are not noted here, but will be indicated in the proposed rulemaking which will reflect the Agency's consideration of comments received. Data and comments on methods of removal and equipment availability are requested in order to assess reasonable limits of mitigating actions. Spill prevention practices and associated costs along with other information thought to be pertinent, such as potential economic impact of implementing the regulations for penalty rates for discharges of non-removable hazardous substances, are also of interest to the Agency. Interested persons may participate in this rulemaking by submitting written comments in triplicate to the EPA Information Center (A-107), Environmental Protection Agency, Washington, D.C. 20460. Attention: Mr. Philip B. Wisman. All communications received on or before October 15, 1974, will be considered by the Administrator before taking action on the proposed rule. After consideration of the available data and comments received in response to this advance notice, a notice of proposed rulemaking will be issued.

The substances which the Agency is considering for designation as hazardous are listed below. For the most part, the nomenclature employed is that common to the trade and where possible is consistent with terms used in standard references such as the Merck Index, Eighth Edition, Merck and Company, Incorporated, Rahway, New Jersey, 1968. Certain compounds have been listed on the basis of the toxic properties of one component such as the anion or cation rather than the specific salt. Radioactive materials are not included in the present advance list of hazardous substances but may be considered as candidate substances for designation in the future. The substances which are indented in the left hand column of the following list are materials for which the toxicological data used were developed on the basis of toxicological properties of one component ion or group of the substance under consideration for designation.

Common name	Synonyms	Isomers
Acetaldehyde	Ethanal, ethyl aldehyde, aldehyde, acetic aldehyde	
Acetic acid	Glacial acetic acid, vinegar acid.	
Acetic anhydride	Acetic oxide, acetyl oxide	
Acetone cyanohydrin	2-methyllactonitrile, alpha-hydroxyisobutyronitrile	
Acetyl bromide		
Acetyl chloride		
Acrolein	2-propenal, acrylic aldehyde, acrylaldehyde, acraldehyde	
Acrylonitrile	Cyanoethylene, Fumigrain, Ventox, propenenitrile, vinyl cyanide.	
Adiponitrile	1,4-dicyanobutane	
Aldrin	Octalene, HHDN	
Allyl alcohol	2-propen-1-ol, 1-propenol-3, vinyl carbinol	
Allyl chloride	3-chloropropene, 3-chloropropylene, Chlorallylene	
Aluminum sulfate	Alum	
Ammonia		
Ammonium compounds:		
Ammonium acetate	Acetic acid ammonium salt	
Ammonium benzoate		
Ammonium bicarbonate	Acid ammonium carbonate, ammonium hydrogen carbonate.	
Ammonium bisulfite		
Ammonium bromide		
Ammonium carbamate	Ammonium aminoformate	
Ammonium carbonate		
Ammonium chloride	Ammonium muriate, sal ammoniac, salmiac, Amchlor	
Ammonium citrate, dibasic.	Diammonium citrate citric acid diammonium salt	
Ammonium ferrocyanide		
Ammonium fluoborate		
Ammonium formate	Formic acid ammonium salt	
Ammonium gluconate		
Ammonium hydroxide		
Ammonium hypophosphite.		
Ammonium iodide		
Ammonium molybdate	Ammonium paramolybdate.	
Ammonium nitrate		
Ammonium oxalate		
Ammonium pentaborate	Ammonium decaborate	
Ammonium persulfate	Ammonium peroxydisulfate	
Ammonium silicofluoride	Ammonium fluosilicate	
Ammonium sulfamate	Ammate, AMS, ammonium amidosulfate	
Ammonium sulfate		
Ammonium sulfide		
Ammonium sulfite		
Ammonium tartrate	Tartaric acid ammonium salt	
Ammonium thiocyanate	Ammonium rhodanide, ammonium sulfocyanate, ammonium sulfocyanide.	
Ammonium thiosulfate	Ammonium hyposulfite.	
Amyl acetate	Amylacetic ester, pear oil, banana oil	normal-; iso-; secondary-; tertiary-amyl acetate.
Aniline	Aniline oil, phenylamine, aminobenzene, aminophen, kyanol.	
Antimony compounds:		
Antimony pentachloride		
Antimony pentafluoride		
Antimony potassium tartrate	Tartar emetic, tartrated antimony, tartarized antimony, potassium antimonyltartrate.	
Antimony tribromide		
Antimony trichloride	Butter of antimony	
Antimony trifluoride	Antimony fluoride	
Antimony triiodide		
Antimony trioxide	Diantimony trioxide, flowers of antimony	
Arsenic compounds:		
Arsenic acid	Orthoarsenic acid	
Arsenic disulfide	Arsenic monosulfide, red arsenic sulfide	
Arsenic pentoxide	Arsenic acid anhydride, arsenic oxide	
Arsenic tribromide	Arsenic bromide, arsenious bromide	
Arsenic trichloride	Arsenic chloride, arsenious chloride, arsenous chloride, butter of arsenic.	
Arsenic trifluoride		
Arsenic triiodide	Arsenic iodide, arsenious iodide, arsenous iodide	
Arsenic trioxide	Arsenious acid, arsenious oxide, white arsenic	
Arsenic trisulfide	Arsenious sulfide, yellow arsenic sulfide	
Cacodylic acid	Dimethylarsinic acid, hydroxydimethylarsine oxide	
Calcium arsenate	tricalcium ortho-arsenate	
Calcium arsenite		
Potassium arsenate		
Potassium arsenite	Potassium metaarsenite	
Sodium arsenate	Disodium arsenate	
Sodium arsenite	Sodium metaarsenite	
Sodium cacodylate	Sodium dimethylarsonate	
Benzene	Cyclohexatriene, benzol	
Benzoic acid	Benzenecarboxylic acid, phenylformic acid, dracylic acid	
Benzonitrile	Phenyl cyanide, cyanobenzene	
Benzoyl chloride	Benzenecarbonyl chloride	
Benzyl chloride		
Beryllium compounds:		
Beryllium chloride		
Beryllium fluoride		
Beryllium hydroxide		
Beryllium nitrate		
Beryllium phosphate		
Beryllium sulfate		

Common name	Synonyms	Isomers
Boric acid	Boracic acid, orthoboric acid	
Brucine	Dimethoxystrychnine	
Butyl acetate	Acetic acid normal-butyl ester, acetic acid secondary-butyl ester, acetic acid iso-butyl ester, acetic acid tertiary-butyl ester.	Normal-; secondary-; iso-; tertiary-butyl acetate.
Butylamine	1-; 2-aminobutane, 2-amino-2-methylpropane, 1-amino-2-methylpropane.	Normal-; secondary-; tertiary-butylamine.
Butyric acid	Butanoic acid, ethylacetic acid	Normal-; iso-butyric acid.
Cadmium compounds:		
Cadmium acetate		
Cadmium bromide		
Cadmium chloride		
Cadmium fluoborate		
Cadmium nitrate		
Cadmium sulfate		
Calcium carbide	Carbide acetylenogen	
Calcium hydroxide	Lime, hydrated, slaked lime, calcium hydrate	
Calcium hypochlorite		
Calcium oxide	Lime quicklime	
Captan	Orthocide-406, SR-406, Vancide-89	
Carbaryl	Sevin	
Carbon disulfide	Carbon bisulfide, dithiocarbonic anhydride	
Catechol	Pyrocatechol, pyrocatechin, ortho-dihydroxybenzene, 1,2-benzenediol.	
Chlordane	Toxichlor	
Chlorine		
Chlorobenzene	Monochlorobenzene, benzene chloride	
Chloroform	Trichloromethane	
Chlorosulfonic acid	Sulfuric chlorohydrin	
Chromium compounds:		
Ammonium bichromate	Ammonium dichromate	
Ammonium chromate		
Calcium chromate	Calcium chrome yellow, gelbin, yellow ultramarine	
Chromic acetate		
Chromic acid	Chromic anhydride, chromium trioxide	
Chromic sulfate		
Chromous carbonate		
Chromous chloride		
Chromous oxalate		
Chromyl chloride	Chromium dioxychloride	
Lithium bichromate	Lithium dichromate	
Lithium chromate		
Potassium bichromate	Potassium dichromate	
Potassium chromate		
Sodium bichromate	Sodium dichromate	
Sodium chromate		
Strontium chromate		
Zinc bichromate	Zinc dichromate	
Cobalt compounds:		
Cobaltous acetate	Cobalt acetate	
Cobaltous bromide	Cobalt bromide	
Cobaltous chloride	Cobalt chloride	
Cobaltous citrate	Cobalt citrate	
Cobaltous fluoride	Cobalt fluoride	
Cobaltous formate	Cobalt formate	
Cobaltous iodide	Cobalt iodide, anhydrous	
Cobaltous nitrate	Cobalt nitrate	
Cobaltous perchlorate	Cobalt perchlorate	
Cobaltous succinate	Cobalt succinate	
Cobaltous sulfamate	Cobalt sulfamate	
Cobaltous sulfate	Cobalt sulfate	
Copper compounds:		
Cupric acetate	Copper acetate, crystallized verdigris	
Cupric acetoarsenite	Copper acetoarsenite, copper acetate arsenite, Paris green.	
Cupric acetylacetonate	Copper 2,4-pentanedione, copper orthoarsenite, Scheel's green.	
Cupric bromide	Copper bromide	
Cupric chloride	Copper chloride	
Cupric formate	Copper formate	
Cupric gluconate	Copper gluconate	
Cupric glycinate	Copper glycinate, cupric aminoacetate.	
Cupric lactate	Copper lactate	
Cupric nitrate	Copper nitrate	
Cupric oxalate	Copper oxalate	
Cupric subacetate	Basic copper acetate	
Cupric sulfate	Copper sulfate	
Cupric sulfate, ammoniated.	Ammoniated copper sulfate	
Cupric tartrate	Copper tartrate	
Cuprous bromide	Copper bromide	
Cuprous iodide	Copper iodide	
Coumaphos	Co-Ral	
Cresol	Cresylic acid, hydroxytoluene	Meta-; ortho-; para-cresol.
Cyanide compounds:		
Barium cyanide		
Calcium cyanide		
Hydrogen cyanide	Hydrocyanic acid	
Potassium cyanide		
Sodium cyanide		
Zinc cyanide		
Cyanogen chloride		
Cyclohexane	Hexahydrobenzene, hexamethylene, hexanaphthene	
2,4-D (acid)	2,4-dichlorophenoxyacetic acid	
2,4-D (esters)	2,4-dichlorophenoxyacetic acid esters	
Dalapon	Dowpon, Gramevin, Radapon, Unipon	
DDT	p,p'-DDT	
Diazinon	Dipofene, Diazitol, Basudin, Spectracide	
Dicamba	2-methoxy-3,6-dichlorobenzoic acid	

Common name	Synonyms	Isomers
Dichlobenil	2,6-dichlorobenzonitrile, 2,6-DBN	
Dichlone	Phygon, dichloronaphthoquinone	
Dichlorvos	2,2-dichlorovinyl dimethyl phosphate, Vapona	
Dieldrin	Alvit	
Diethylamine		
Dimethylamine		
Dinitrobenzene	Dinitrobenzol	Meta-; ortho-; para-dinitrobenzol.
Dinitrophenol	Aldifen	2,3-; 2,4-; 2,5-; 2,6-; 3,4-; 3,5-dinitrophenol.
Diquat	Aquacide, Dextrone, Reglone, Diquat dibromide	
Disulfoton	Di-syston	
Diuron	DCMU, DMU	
Dodecylbenzenesulfonic acid		
Dodecylbenzenesulfonic acid, calcium salt.		
Dodecylbenzenesulfonic acid, isopropanolamine salt.		
Dodecylbenzenesulfonic acid, sodium salt.		
Dodecylbenzenesulfonic acid, triethanolamine salt.		
Dursban	Chlorpyrifos	
Endosulfan	Thiodan	
Endrin	Mendrin, Compound 269	
Ethion	Nialate	
Ethylbenzene		
Ethylenediamine	1,2-diaminoethane	
Ethylenediamine-tetraacetic acid	EDTA, edetic acid, Havidote (ethylenedinitrilo)-tetraacetic acid.	
Fluorine compounds:		
Aluminum fluoride	Aluminum trifluoride	
Ammonium bifluoride	Acid ammonium fluoride, ammonium hydrogen fluoride	
Ammonium fluoride	Neutral ammonium fluoride	
Hydrofluoric acid	Fluohydric acid	
Lithium fluoride		
Phosphorus pentafluoride		
Sodium bifluoride		
Sodium fluoride	Villiaumite	
Stannous fluoride		
Formaldehyde	Methyl aldehyde, methanal, formalin	
Formic acid	Methanoic acid	
Fumaric acid	Trans-butenedioic acid, trans-1,2-ethylene-dicarboxylic acid, boletic acid, allomaleic acid.	
Furfural	2-furaldehyde, pyromucic aldehyde	
Guthion	Gusathion, azinphos-methyl	
Heptachlor	Velsicol-104, Drinox, Heptagran	
Hydrochloric acid	Hydrogen chloride, muriatic acid	
Hydroquinone	Para-dihydroxybenzene, 1,4-benzenediol, hydroquinol, quinol Tecquinol.	
Hydroxylamine	Oxammonium	
Iron compounds:		
Ferric ammonium citrate	Ammonium ferric citrate	
Ferric ammonium oxalate	Ammonium ferric oxalate	
Ferric chloride	Flores martis, iron trichloride	
Ferric fluoride		
Ferric glycerophosphate	Iron glycerophosphate	
Ferric nitrate	Iron nitrate	
Ferric phosphate		
Ferric sulfate	Ferric persulfate, ferric sesquisulfate, ferric tersulfate	
Ferrous ammonium sulfate	Mohr's salt, iron ammonium sulfate	
Ferrous chloride	Iron chloride, iron dichloride, iron protochloride	
Ferrous oxalate	Iron oxalate, Ferrox	
Ferrous sulfate	Green vitriol, iron vitriol, iron sulfate, iron protosulfate	
Isoprene	2-methyl-1,3-butadiene	
Kelthane	Di(p-chlorophenyl)-trichloromethylcarbinol DTMC, dicofol.	
Lead compounds:		
Lead acetate	Sugar of lead	
Lead arsenate		
Lead bromide		
Lead chloride		
Lead fluoborate		
Lead fluoride	Lead difluoride plumbous fluoride	
Lead iodide		
Lead nitrate		
Lead stearate	Stearic acid lead salt	
Lead sulfate		
Lead sulfide	Galena	
Lead tetraacetate		
Lead thiocyanate	Lead sulfocyanate	
Lead thiosulfate		
Lead tungstate		
Lindane	Gamma-BHC, gamma-benzene hexachloride	
Malathion	Phosphothion	
Maleic acid	cis-Butenedioic acid, cis-1,2-ethylenedicarboxylic acid, toxilic acid.	
Maleic anhydride	2,5-furandione, cis-butenedioic anhydride, toxilic anhydride.	
Mercury compounds:		
Mercuric acetate	Mercury acetate	
Mercuric ammonium chloride	Mercury ammonium chloride ammonium tetrachloromercurate (II).	
Mercuric bromide	Mercury bromide	
Mercuric chloride	Mercury bichloride, mercury perchloride	
Mercuric cyanide	Mercury cyanide	
Mercuric iodide	Mercury biniodide	
Mercuric nitrate	Mercury nitrate, mercury pernitrate	
Mercuric oxide	Mercury oxide, red precipitate, red mercuric oxide, yellow precipitate, yellow mercuric oxide.	
Mercuric sulfate	Mercury sulfate, mercury persulfate, mercury bisulfate	
Mercuric thiocyanate	Mercury thiocyanate, mercuric sulfocyanate, mercuric sulfocyanide.	

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Common name	Synonyms	Isomers
Mercurous chloride	Mercury monochloride, mercury protochloride, mild mercury chloride, calomel, Calogreen, Cyclosan.	
Mercurous iodide	Yellow mercury iodide, mercury protoiodide	
Mercurous nitrate	Mercury protonitrate	
Methoxychlor	DMDT, methoxy-DDT	
Methyl mercaptan	Methanethiol, mercaptomethane, methyl sulfhydrate, thiomethyl alcohol.	
Methyl methacrylate	Methacrylic acid methyl ester, methyl-2-methyl-2-propenoate.	
Methyl parathion	Nitrox-80	
Mevinphos	Phosdrin	
Molybdic trioxide	Molybdenum trioxide, molybdic anhydride	
Monoethylamine	Ethylamine, aminoethane	
Monomethylamine	Methylamine, aminomethane	
Naled	Dibrom	
Naphthalene	White tar, tar camphor, naphthalin	
Naphthenic acid	Cyclohexanecarboxylic acid hexahydrobenzoic acid	
Nickel compounds:		
Nickel acetate		
Nickel ammonium sulfate	Ammonium nickel sulfate.	
Nickel bromide	Nickelous bromide	
Nickel chloride	Nickelous chloride	
Nickel fluoride		
Nickel formate		
Nickel hydroxide	Nickelous hydroxide	
Nickel iodide		
Nickel nitrate		
Nickel perchlorate		
Nickel sulfate	Nickelous sulfate	
Nitric acid	Aqua fortis	
Nitrobenzene	Nitrobenzol, oil of mirbane	
Nitrogen dioxide	Nitrogen tetraoxide	
Nitrophenol	Mononitrophenol	Meta-; ortho-; paranitrophenol.
Paraformaldehyde	Paraform, Formagene, Triformol, polymerized formaldehyde, polyoxymethylene.	
Parathion	DNTP, Niran	
Pentachlorophenol	PCP, Penta	
Phenol	Carbolic acid, phenyl hydroxide, hydroxybenzene, oxybenzene.	
Phosgene	Diphosgene, carbonyl chloride, chloroformyl chloride	
Phosphoric acid	Orthophosphoric acid	
Phosphorus	Black phosphorus, red phosphorus, white phosphorus, yellow phosphorus.	
Phosphorus oxychloride	Phosphoryl chloride, phosphorus chloride.	
Phosphorus pentasulfide	Phosphoric sulfide, thiophosphoric anhydride, phosphorus persulfide.	
Phosphorus trichloride	Phosphorous chloride	
Polychlorinated biphenyls	PCB, Aroclor, Polychlorinated diphenyl.	
Potassium hydroxide	Potassium hydrate, caustic potash, potassa	
Potassium permanganate	Chameleon mineral	
Propionic acid	Propanoic acid, methylacetic acid, ethylformic acid	
Propionic anhydride	Propanoic anhydride, methylacetic anhydride	
Propyl alcohol	Ethyl carbinol, propylic alcohol, propanol	Normal-; (isopropyl alcohol).
Pyrethrins	Pyrethrin I, Pyrethrin II	
Pyrogallic acid	1,2,3-trihydroxybenzene, pyrogallol, 1,2,3-benzenetriol	
Quinoline	1-benzazine, benzo[b]pyridine, leucoline, chinoleine, leucol.	
Resorcinol	Resorcin, 1,3-benzenediol, meta-dihydroxybenzene	
Selenium compounds:		
Selenic acid		
Selenium oxide	Selenium dioxide	
Selenium oxychloride	Seleninyl chloride	
Sodium selenite		
Sodium	Natrium	
Sodium bisulfite	Sodium acid sulfite, sodium hydrogen sulfite	
Sodium borate	Sodium biborate, sodium pyroborate, sodium tetraborate	
Sodium hydrosulfide	Sodium sulfhydrate	
Sodium hydroxide	Caustic soda, soda lye, sodium hydrate	
Sodium hypochlorite	Bleach	
Sodium methylate	Sodium methoxide	
Sodium nitrite		
Sodium phosphate, dibasic		
Sodium phosphate, monobasic		
Sodium phosphate, tribasic		
Sodium silicate	Water glass, soluble glass	
Sodium sulfide		
Strychnine		
Styrene	Vinylbenzene, phenylethylene, styrol, styrolene, cinnamene, cinnamol.	
Sulfuric acid	Oil of vitriol, oleum	
Sulfur monochloride	Sulfur chloride	
2,4,5-T (acid)	2,4,5-trichlorophenoxyacetic acid	
2,4,5-T (esters)	2,4,5-trichlorophenoxyacetic esters	
Tannic acid	Tannin, gallotannin, gallotannic acid	
TDE	DDD	
Tetraethyl lead	Lead tetraethyl, TEL	
Tetraethyl pyrophosphate	TEPP	
Toluene	Toluol, methylbenzene, phenylmethane, Methacide	
Toxaphene	Camphechlor	
Trichlorfon	Dipterex, Dylox	
Trichlorophenol	Collunosol, Dowicide 2 or 2S, Omal, Phenachlor	
Triethylamine		
Trimethylamine	TMA	
Uranium compounds:		
Uranium peroxide		
Uranyl acetate		
Uranyl nitrate		
Uranyl sulfate		
Vanadium compounds:		
Vanadium oxytrichloride	Vanadyl trichloride	
Vanadium pentoxide	Vanadic anhydride, vanadic acid anhydride	
Vanadyl sulfate	Vanadic sulfate, vanadium sulfate	
Vinyl acetate	Acetic acid ethylene ether	
Xylene	Dimethylbenzene, xylol	Meta-; ortho-; para-xylene.
Xylenol	Dimethylphenol, hydroxydimethyl benzene	
Zectran	Mexacarbate	

Common name	Synonyms	Isomers
Zinc compounds:		
Zinc acetate		
Zinc ammonium chloride		
Zinc ammonium sulfate		
Zinc borate		
Zinc bromide		
Zinc carbonate		
Zinc chloride	Butter of zinc	
Zinc fluoride		
Zinc formate		
Zinc hydrosulfite		
Zinc nitrate		
Zinc permanganate		
Zinc phenolsulfonate	Zinc sulfocarbolate	
Zinc phosphide		
Zinc potassium chromate	Zinc yellow, citron yellow, buttercup yellow, zinc chrome.	
Zinc propionate		
Zinc silicofluoride	Zinc fluosilicate	
Zinc sulfate	White vitriol, zinc vitriol, white copperas	
Zinc sulfate, monohydrate.		
Zirconium compounds:		
Zirconium acetate		
Zirconium ammonium fluoride.		
Zirconium potassium fluoride.		
Zirconium nitrate		
Zirconium oxychloride	Zirconyl chloride, zirconium chloride, basic.	
Zirconium sulfate	Disulfatozirconic acid	
Zirconium tetrachloride		

This advance notice of proposed rulemaking is issued under authority of section 311 and section 501 of the Federal Water Pollution Control Act as amended (33 U.S.C. 1251 et seq.).

Dated: August 16, 1974.

James L. Agee,
Assistant Administrator for Water and Hazardous Materials.

[FR Doc.74-19234 Filed 8-21-74;8:45 am]

APPENDIX B

THE HAZARDOUS WASTE DECISION MODEL

THE HAZARDOUS WASTE DECISION MODEL

The hazardous waste decision model is designed to reorient the pure compound approach to a more objective methodology. The use of comparative threshold levels is retained, but the basic criteria for judgment are expanded to cover a full range of hazard types. Constituent interactions are taken into account as fully as possible by use of available waste stream data.

The selection process is analogous to a screening operation. Candidate wastes are examined in a manner illustrated by the logic diagram, Figure 1. Affirmative response to any of the criteria, or screens, automatically qualifies the waste as hazardous. All wastes are considered candidates for the screening procedure, regardless of production quantities. While low volume streams will be unimportant in designing individual treatment facilities, they must be classified and regulated as hazardous if their intrinsic properties so warrant.

A subjective treatability assessment is avoided by evaluating waste streams as they exit the plant's boundaries. Hence, if on-site processing adequately reduces waste stream properties below the designated thresholds, the resulting discharges will not be classified as hazardous. On the other hand, sludges or concentrates resulting from on-site treatment may well be sufficiently dangerous to qualify as hazardous. These by-product streams would then be so designated.

This concept allows for continual updating of designations and regulations as new production techniques and treatment systems modify existing wastes and as new wastes are produced. The rationale for the thresholds selected for use in the hazardous waste decision model follow.

Radioactivity

The purpose of this screen is to designate all waste streams containing radioisotopes above the accepted maximum permissible concentration (MPC) levels as hazardous. The actual MPC levels as set by the Atomic Energy Commission (AEC) are in a state of transition; therefore the screen is formulated to accommodate whatever standards exist at the time of the evaluation. Present values are currently under review and may be reduced in the near future. Should this occur, re-evaluation of radioisotope-bearing streams may be necessary.

The MPC levels are appropriate for use in a scheme such as this, since they are in part developed to specify discharge levels. Consequently, their use renders the screen compatible with

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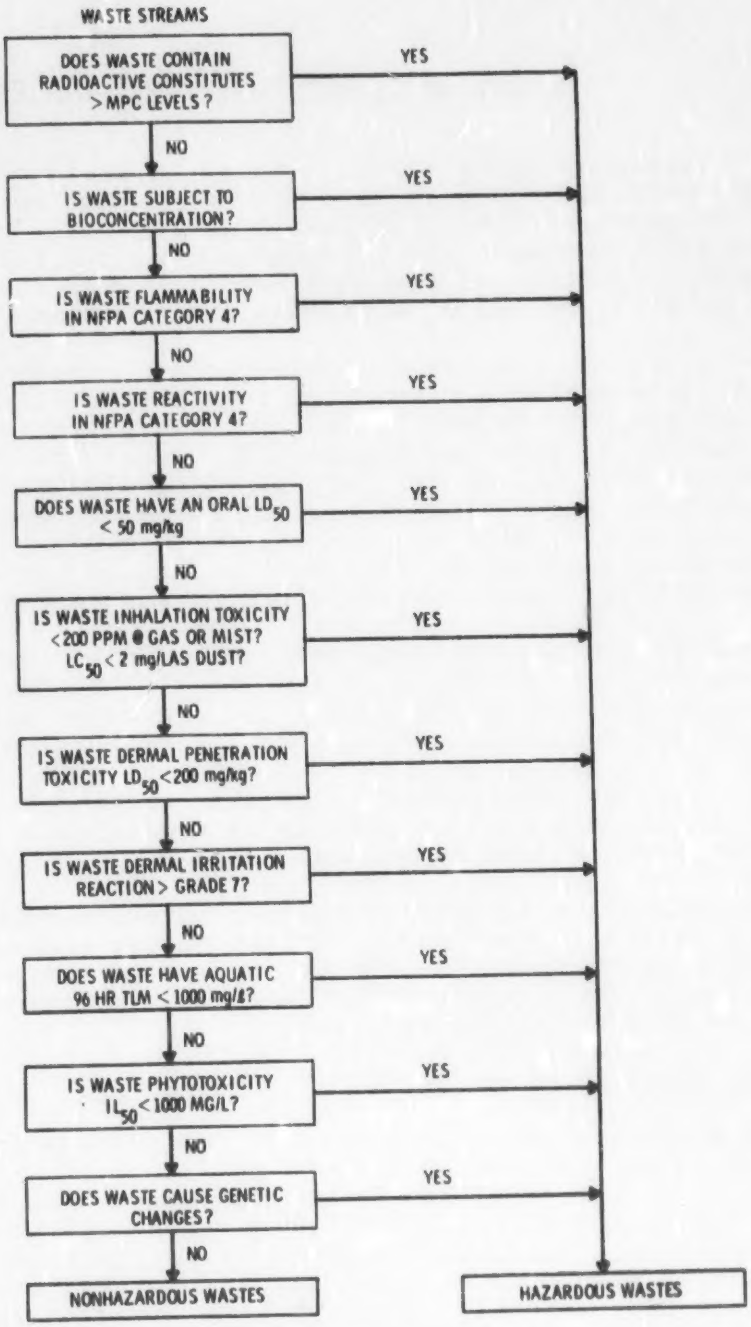
WASTE STREAMS
DOES WASTE CONTAIN RADIOACTIVE CONSTITUTES > MPC LEVELS?
IS WASTE SUBJECT TO BIOCONCENTRATION?
IS WASTE FLAMMABILITY IN NFPA CATEGORY 4?
IS WASTE REACTIVITY IN NFPA CATEGORY 4?
DOES WASTE HAVE AN ORAL LD50 < 50 mg/kg
IS WASTE INHALATION TOXICITY <200 PPM @ GAS OR MIST? LC50 < 2 mg/LAS DUST?
IS WASTE DERMAL PENETRATION TOXICITY LD50 <200 mg/kg?
IS WASTE DERMAL IRRITATION REACTION > GRADE 7?
DOES WASTE HAVE AQUATIC 96 HR TLM < 1000 mg/ℓ?
IS WASTE PHYTOTOXICITY IL50 < 1000 MG/L?
DOES WASTE CAUSE GENETIC CHANGES?
YES
NO
NONHAZARDOUS WASTES
HAZARDOUS WASTES

FIGURE B-1. GRAPHIC REPRESENTATION OF THE HAZARDOUS WASTE DECISION MODEL existing AEC regulations and draws on the wealth of research and experience which stands behind the initial selection of those values

Bioconcentration

The terms bioconcentration, bioaccumulation, and biomagnification are often used interchangeably to describe the phenomenon by which living organisms concentrate an element or compound to levels in excess of those in the surrounding environment. Kneip and Lauer[1] define the three terms in the following manner:

> Bioconcentration refers to the ability of an organism or a population of many organisms of the same trophic level to concentrate a substance from an aquatic system.
>
> Bioaccumulation refers to the ability of an organism to not only concentrate, but to continue to concentrate essentially throughout its active metabolic lifetime, such that the 'concentration factor', if calculated would be continuously increasing during its lifetime.
>
> Biomagnification is the term which should be used when a substance is found to exist at successively higher concentrations with increasing trophic levels in ecosystem food chains.

It should be noted that concentration factor is defined here as the ratio of the concentration of the material of interest in the organism to the concentration of that material in the environment or the preceding link in the food chain.[2]

Employing these definitions, the purpose of the screen is to identify and designate as hazardous those wastes which display a concentration factor in higher organisms, here defined as mammals, fish, birds, mollusks, macrocrustacea, reptiles and amphibians. The screen is not relevant to materials with cumulative effects or materials for which substantial nutritional requirements have been established. In general, bioconcentrated materials as defined here are ones for which the detoxification-excretion mechanism is either non-existent or extremely slow.

Bioconcentrative materials can be grouped into two categories based on retention mechanisms. The first includes the heavy metals such as mercury and lead. These materials, through a strong affinity characteristic with sulfhydryl groups and disulfide bonds, are capable of inactivating or denaturing enzymes and proteins, thus blocking normal metabolic pathways, interfering with control mechanisms and crippling cellular integrity. The second category of bioconcentrative substances is represented by persistent organic materials such as DDT and PCBs. These materials concentrate through an affinity for non-polar solvents and low solubility in water. The contaminants quickly migrate to fatty tissues or lipid cellular fractions where they typically cause hepatic disorders (disorders of the functions of the liver).

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[1] Kenip, T. J. and G. J. Lauer. Progress in Analytical Chemistry, Galen Ewing, Inc., Plenum Press, New York, 1973.

[2] Polikarpov, G. G. Radioecology of Aquatic Organisms, Reinhold Book Division, New York, 1966.

Evaluating the data on bioconcentration can be very difficult since no standard bioassay or testing procedure has been adopted by which the bioconcentration potential of a material can be consistently assessed. Present plans call for such a protocol to be developed by the EPA.[3] Until such a standard testing procedure is developed, literature sources documenting environmental build-up of a material or laboratory studies indicating less than complete elimination or detoxification of a material by one of the higher organisms of animal life one week after exposure will be used to select substances under this criterion. This evaluation is presently included in the selection procedure proposed by the Division of Oil and Hazardous Materials (DOHM) of the EPA for designation of hazardous substances. Use of this criterion and any standard testing protocol devised by the EPA will insure compatibility with related governmental activities.

Flammability

All waste streams qualifying as Category 4 flammable materials by the National Fire Protection Association[4] will be included as hazardous wastes. Included in the Category 4 flammability rating are

> very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

Examples of pure compounds receiving the Category 4 flammability rating are methyl ethyl ether and n-butane. Improper disposal of materials such as these would constitute a public hazard.

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[3] Personal communication. Analytical Quality Control Laboratory, National Environmental Research Center, Cincinnati, Ohio, February 1971.

[4] National Fire Protection Association. Fire Protection Guide on Hazardous Materials, Boston, Massachusetts, 1972.

Wastes may include a variety of constituents which in combination qualify as Category 4 or whose interactive by-product qualify as Category 4. In practice, wastes may or may not be readily classified utilizing only data on the constituents in the waste streams. The decision to classify materials as Category 4 is a judgmental one. In general, materials qualify as Category 4 flammables if they are:

1. flammable gases;
2. flammable liquids with boiling points below 100°F and vapor densities $\geq$ 1.1 (density is measured as the radio of the weight of a volume of vapor to an equal volume of dry air under similar conditions);
3. flammable liquids with flash points below 100°F and vapor-air densities $\geq$ 1.1; and
4. spontaneously combustible in air.

The vapor and vapor-air density data are meant to account for the hazard of vapors traveling along the ground to an ignition source and then flashing back. This could be a real hazard in landfill operations where heavy equipment exhaust or sparks could ignite escaping vapors. The Category 4 rating is roughly equivalent to a Grade 4 rating on the NAS fire hazard scale.[5]

Reactivity

All waste streams qualifying as Category 4 reactive materials by the National Fire Protection Association[6] will be included as hazardous wastes. Included in the Category 4 reactivity rating are those

> ...materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

Examples of materials in the Category 4 reactivity rating include contaminated benzoyl peroxides and off-spec nitro-methane. Improper disposal of materials in this category would constitute a public hazard.

Judging the reactive hazard level of complex wastes will be a difficult task. The major areas of concern will include:

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[5] National Academy of Sciences. "Evaluation of the Hazard of Bulk Water Transportation of Industrial Chemicals, A Tentative Guide," Report to U. S. Coast Guard, Washington, D. C., 1970.

[6] Op. Cit. 4.

- Detonation by Electrical Shock - Some materials can be detonated by electrostatic charge and as such pose a reactive hazard in various environments. Data pertinent to this hazard can be found in the National Electrical Code (NFPA No. 70).[7]

- Oxidizing Materials - Strong oxidizing agents such as chlorates, perchlorates, bromates, peroxides, nitric acid, nitrates, nitrites, and permanganates are highly sensitive to heat, friction, and impact when in the presence of combustible materials. Mixtures of oxidizing and combustible materials should be considered Category 4 reactive. This would include Grade 4 self-reactive materials in the NAS rating system.[8]

- Polymerization - Certain hazardous wastes are capable of autopolymerization. By-product heat and pressure increases present a danger. Wastes containing materials with this potential should be considered Category 4 reactive. The presence of inhibitors may not be sufficient to reduce the hazard since biological, chemical or thermal action may negate the inhibiting effect. This would include Grade 3 self-reactive agents in the NAS rating system.[8]

- Explosiveness - Wastes containing primary high explosives at any but dilute concentrations should be considered Category 4 reactive. Primary high explosives are defined as those materials which detonate, releasing energy very rapidly and creating very high pressures. Detonation can result from friction, impact, shock or heat. Primary high explosives are rated at 5 inches or less on the Picatinny Arsenal scale.

- Water or Air Reactive - Wastes may also be considered Category 4 if they react violently when exposed to air or water. This would include materials rated as Grade 4 water reactive in the NAS rating system.[8]

Many of these decision factors have not been quantified. The NFPA selection committee relied largely on a consensus approach. Their findings, however, on pure compounds should serve as guidelines for extrapolation to wastes.

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[7] National Electrical Code -- NFPA No. 70, National Fire Protection Association, Boston, 1972.

[8] Op. Cit. 5.

Oral Toxicity

Waste streams found to have an oral LD_{50} to man or rats less than or equal to 50 mg/kg body weight are considered hazardous. The LD_{50} is defined as the dose at which 50 percent of the test population succumbs. The level of 50 mg/kg was selected to comply with existing EPA regulations (40 CFR Section 162.8) and DOT advanced notice of proposed rule making (Docket No. HM-51, Fed. Reg., Vol. 36, No. 30, February 12, 1971) designating substances either extremely or highly toxic. An LD_{50} of 50 mg/kg or less also matches the NAS toxicity rating of Grade 4.[9] The EPA Division of Oil and Hazardous Materials is also proposing this threshold for designation of hazardous substances.

A large quantity of data on test organisms other than humans or rats and on routes of administration other than oral are available. Often these data may be extrapolated to estimate an oral LD_{50} value for man or rats. Table B-1 lists comparative toxic levels outlined by the Department of Health, Education and Welfare[10] which may be used for this purpose.

The oral ingestion route is selected to represent the potential for leaching of landfilled materials into water supplies. Testing procedures for oral toxicity should provide for single dose administration followed by a 14 day observation period. Further information on detailed test conditions can be found in Title 21 of CFR, Section 191.10; the Federal Register, Vol. 36, No. 30, February 12, 1971; and Title 40 of CFR, Section 162.8

Inhalation Toxicity

Wastes demonstrating an inhalation LC_{50} of 200 ppm or less as a vapor or 2 mg/l or less as a dust or aerosol are considered hazardous. The LC_{50} is the concentration at which 50 percent of the test population succumbs. The levels selected comply with those set by EPA regulations (40 CFR Section 162.8) and DOT advanced notice of proposed rule-making (Docket No. HM-51, Fed. Reg., Vol. 36, No. 30, February 12, 1971) to designate extremely and highly toxic materials. The Division of Oil and Hazardous Materials within the EPA is also proposing this threshold for designation of hazardous substances.

Inhalation toxicity can be of importance for a variety of waste-related activities including vapors escaping from landfills, off gases from combustion processes, and operator exposure during processing, shipment, and disposal. A great deal of

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[9] Ibid.

[10] Toxic Substances, U. S. Department of Health, Education and Welfare, Rockville, Maryland, 1971.

TABLE B-1

LIMITING DOSAGES DIFFERENTIATING TOXIC AND NONTOXIC SUBSTANCES ACCORDING TO ROUTE OF ADMINISTRATION TO EXPERIMENTAL ANIMALS OF MAXIMUM SINGLE (ACUTE)[1] DOSE CAUSING DEATH[3]

	ROUTES OF ADMINISTRATION (WITH LIST ABBREVIATIONS)								
SPECIES (with list designations)	Oral (orl) Rectal (rec)	Inhalation (ihl) 8 hr.		Skin (skn)	Intraperitoneal (ipr) Intrapleural (ipl)	Parenteral Subcutaneous (scu) Intradermal (idr) Implant (imp)	Intravenous (ivn) Intramuscular (ims) Ocular (ocu) Intracerebral (ice) Intratracheal (itr)	Other (par)	Unreported (unk)
	mg/Kg	ppm	mg/M	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Mouse (mus), Hamster (ham), Frog (frg), Gerbil (grb)	2500	5000	1000	1400	1000	5000	750	1000	2500
Rat (rat), Squirrel (sql) Mammal, unspecified (mam)	5000[2]	10000	2000	2800	2000	10000[2]	1500	2000	5000
Rabbit (rbt) Guinea Pig (gpg), Chicken (ckn), Pigeon (pgn), Quail (qal), Duck (dck), Turkey (trk), Bird (brd)	10000	20000	4000	2800[2]	4000	20000	3000	4000	10000
Dog (dog), Monkey (mky), Cat (cat) Pig (pig), Cattle (ctl), Domestic Animals: sheep, goat, horse (dom)	10000	20000	4000	5600	4000	20000	3000	4000	10000

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[1] Applies to those substances for which acute toxicity characterizes the response, fast-acting substances, irritants, narcous-producing substances, most drugs, does not apply to substances whose characteristic response results from prolonged exposure, e.g., silica, lead, benzene, carbon disulfide, carcinogens. Concentrations more appropriately characterizing the toxicity of long- or slow-acting substances are derived from long-term, chronic toxicity studies.

[2] From Hine and Jacobson, Am. Ind. Hyg. Assn. Quart. *15*, 141, 1954.

[3] Calculated from experimental data (Stokinger).

information on exposure limits for eight hour working days has been published as Threshold Limit Values (TLV's).[11] While these regulated levels are not of interest in the decision model itself, they are typically estimated on LC_{50} data. These initial toxicological findings should provide an excellent source of data on pure compounds.

Tests to determine the inhalation toxicity hazards of wastes should be designed around a 24 hour exposure time followed by a 14 day observation period. Further information on testing procedures can be found in Title 40 CFR, Section 162.8; Title 21 DFR, Section 191.10; and the Fed. Reg., Vol. 36, No. 30, February 12, 1971.

Dermal Penetration

A waste with a dermal LD_{50} of 200 mg/kg body weight or less is considered hazardous. The LD_{50} is defined as the dose at which 50 percent of the test population succumbs. The level of 50 mg/kg was selected to comply with existing EPA regulations (40 DRF, Section 162.8) and DOT advanced notice of proposed rule making (Docket No. HM-51, Fed. Reg., Vol. 36, No. 30, February 12, 1971) designating substanced either extremely or highly toxic. The Division of Oil and Hazardous Materials within the EPA is also proposing this threshold for designation of hazardous substances.

The dermal penetration route of administration must be considered since a contact hazard exists both for landfill areas and discharges into surface waters. Data on dermal penetration can be found in classical toxicology manuals as well as in the reports of Smyth, et al.[12-19]

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[11] "Threshold Limit Values of Airborne Contaminants," American Conference of Governmental Industrial Hygienists, 1970.

[12] Smyth, H. F., C. P. Carpenter, and C. S. Weil. "Range-Finding Toxicity Data: List IV," AMA Archives of Industrial Hygiene and Occupational Medicine, 4:119-122, 1951.

[13] Smyth, H. F., C. P. Carpenter, C. S. Weil, U. C. Pozzani, J. A. Striegel, and J. S. Nycum. "Range-Finding Toxicity Data: List IV," American Industrial Hygiene Association Journal, 30:470-476, 1969.

[14] Smyth, H. F., C. P. Carpenter, C. S. Weil, U. C. Pozzani, and J. A. Striegel. "Range-Finding Toxicity Data: List VI," American Industrial Hygiene Association Journal, 23:95-107, 1972.

[15] Smyth, H. F., C. P. Carpenter, C. S. Weil, and U. C. Pozzani. "Range-Finding Toxicity Data: List V," AMA Archives of Industrial Hygiene and Occupational Medicine, 10:61-68, 1954.

[16] Smyth, H. F., C. P. Carpenter, and C. S. Weil. "Range-Finding Toxicity Data: List III," Journal of Industrial Hygiene and Toxicology, 31:60-62, 1949.

Testing procedures for dermal toxicity should provide for one hour of exposure followed by a 14 day observation period. Further details for testing can be found in Title 40 CFR, Section 162.8, No. 30, February 1971.

Dermal Irritation

Wastes scoring eight or better on the FDA skin irritation evaluation are considered hazardous. This threshold represents moderate or severe edema and erythema on rabbit skins after a 24 hour exposure period. Tests are made on shaved and abraded skin as prescribed in Title 21 CFR, Section 191.1. Additionally, wastes rating Grade 8 or better on the irritation evaluation 10-grade ordinal scale devised by Smyth, et al.,[12-19] can also be classed hazardous. Here, the material rating is derived as the severest reaction obtained on any of five albino rabbits after a 24 hour exposure of 0.01 ml of sample or solution in water, acetone, or propylene glycol.

Grade 1 on the above scale indicates no irritation; Grade 2 is evidenced by the least visible capillary injection from the undiluted chemical. Grade 6 indicates necrosis when applied undiluted; Grade 8 indicates necrosis after application of a 1 percent solution; and Grade 10 relates to necrosis from a 0.01 percent solution. A Grade 8 rating was selected for the threshold because it represents severe irritant effects after a dilution of 100 to 1.

Aquatic Toxicity

A waste displaying a 96 hour TLm of 1000 ppm or less is considered hazardous. TLm refers to the median threshold limit, or the concentration at which a material is lethal to one-half of the test population. A limit of 1000 ppm was selected to comply with thresholds now being proposed by the Division of Oil and Hazardous Materials within the EPA. This justification is based upon concentration levels likely to occur after 1, 3, and 6 hour discharges of tank truck, tank car, and tank barge quantities into various sized streams. Employing a general dispersion model, materials with a 96 hour TLm of 1000 ppm or less may persist at those levels long enough to cause significant damage to

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[17] Smyth, H. F., J. Seaton, and L. Fischer. "The Single Dose Toxicity of Some Glycols and Derivatives," Journal of Industrial Hygiene and Toxicology, 23(6):259-268, 1941.

[18] Smyth, H. F. and C. P. Carpenter. "Further Experience with the Range-Finding Test in the Industrial Toxicology Laboratory," Journal of Industrial Hygiene and Toxicology, 30:63-68, 1948.

[19] Smyth, H. F. and C. P. Carpenter. "The Place of the Range-Finding Test in the Industrial Toxicology Laboratory," Journal of Industrial Hygiene and Toxicology, 26:269-273, 1944.

aquatic life. Materials with higher TLm values are not likely to cause significant damage. The 1000 ppm or less level correlates with NAS ratings of Grade 2-4 for aquatic toxicity.[20]

Aquatic hazards may result from landfill leachate or direct dumping. The threat is of importance to various fish varieties and fish food organisms.

Testing should follow accepted static or flow-through bioassay techniques for a 96 hour exposure period. Detailed procedures are available in Standard Methods.[21] A great deal of data on aquatic toxicity of pure compounds and wastes has been collected by McKee and Wolfe[22] and by Battelle-Columbus.[23]

Phytotoxicity

A waste displaying an ILm of 1000 ppm or less is considered hazardous. The ILm is defined as the median inhibitory limit, or that concentration at which a 50 percent reduction in the biomass, cell count, or photosynthetic activity of the test culture occurs when compared to a control culture over a 14 day period. The 1000 ppm level was selected for reason similar to those for selection of the aquatic toxicity threshold.

Plant toxicity is of concern both from the standpoint of damage to commercial operations and damage to aquatic plants which form an important link in the food chain. Plants may be threatened by landfill leachate or direct dumping into surface waters or waters destined for irrigation use.

While no standard testing procedures have been published to date, personnel at the EPA National Environmental Research Center (NERC) in Cincinnati will soon issue a manual containing the necessary testing details.[24] Data on phytotoxicity of pure materials and wastes can be found in McKee and Wolfe,[25] The

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[20] Op. Cit. 5.

[21] "Standard Methods for the Examination of Water and Wastewater," 13th Edition, American Public Health Association, Washington, D. C., 1971.

[22] McKee, J. E. and H. W. Wolf. "Water Quality Criteria," California State Water Quality Control Board, Second Edition, April 1971.

[23] Battelle Memorial Institute. "Water Quality Criterion Book, Volume III," Environmental Protection Agency, 18050 GWV, May 1971.

[24] Op. Cit. 3.

[25] Op. Cit. 22.

Water Quality Criteria Data Book, Volume 3[26] and the Oil and Hazardous Materials - Technical Assistance Data System (OHM-TADS) files maintained by the EPA.[27]

Genetic Effects

Wastes found to give positive results to standard genetic effects tests are considered hazardous. Effects may be grouped into three major subcategories:

> Carcinogens - Standard tests for carcinogenic behavior have been promulgated and catalogued by the National Cancer Institute.[28] Any of the accepted procedures described in various NCI publications should be adequate for testing.
>
> Mutagens - Standard mutagen tests have been developed by Weissgunger at the National Cancer Institute.[28] There are also several standardized procedures described by Epstein and Legator.[29] Mutagenic effects in bacterial and plant cultures have never been translated into impact on man, but mutagenesis in any sector of the environment may utlimately be of importance and should be considered hazardous until potential correlations are more clearly defined.
>
> Teratogens - Standard teratogenic potential tests are quite well accepted. They are typically conducted on pregnant New Zealand rabbits. Detailed procedures can be obtained from the National Cancer Institute.

Because genetic effects potential testing is both time-consuming and costly, all wastes should not be subjected to a rigid battery of evaluations. Rather, tests should be required only of those wastes in which known carcinogens, mutagens, or teratogens are known to occur or are strongly suspected of occurring. The National Cancer Institute publishes a list of known carcinogens.[28] Similarly, Epstein has catalogued mutagens.[29] Data on teratogens is somewhat more scattered, but can be found in Volumes 1 and 2 of the Water Quality Criteria Data Book.[30,31] The Department of Health, Education and Welfare also identifies genetic effects potential in their Toxic Substances publication.[10]

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[26] Op. Cit. 23.

[27] "Oil and Hazardous Materials Technical Assistance Date System," Division of Oil and Hazardous Materials, Office of Water Programs, EPA.

[28] Personal communication, Ralph Wands, Director of Advisory Center on Toxicology, National Academy of Science, 1973.

[29] Epstein, S. S. and M. S. Legator. "The Mutagenicity of Pesticides: Concepts and Evaluations," The MIT Press, Cambridge, Massachusetts, 1971.

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[30] "Water Quality Criteria Data Book, Volume 1," Arthur D. Little, Inc., December 1970.

[31] "Water Quality Criteria Data Book, Volume 2," Arthur D. Little, Inc., July 1971.

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4. National Fire Protection Association. Fire Protection Guide on Hazardous Materials, Boston, Massachusetts, 1972.

5. National Academy of Sciences. "Evaluation of the Hazard of Bulk Water Transportation of Industrial Chemicals, A Tentative Guide," Report to U. S. Coast Guard, Washington, D. C., 1970.

6. Op. Cit. 4.

7. National Electrical Code -- NFPA No. 70, National Fire Protection Association, Boston, 1972.

8. Op. Cit. 5.

9. Ibid.

10. Toxic Substances, U. S. Department of Health, Education and Welfare, Rockville, Maryland, 1971.

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14. Smyth, H. F., C. P. Carpenter, C. S. Weil, U. C. Pozzani, and J. A. Striegel. "Range-Finding Toxicity Data: List VI," American Industrial Hygiene Association Journal, 23:95-107, 1972.

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15. Smyth, H. F., C. P. Carpenter, C. S. Weil and U. C. Pozzani. "Range-Finding Toxicity Data: List V," *AMA Archives of Industrial Hygiene and Occupational Medicine*, 10:61-68, 1954.

16. Smyth, H. F., C. P. Carpenter and C. S. Weil. "Range-Finding Toxicity Data: List III," *Journal of Industrial Hygiene and Toxicology*, 31:60-62, 1949.

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24. Op. Cit. 3.

25. Op. Cit. 22.

26. Op. Cit. 23.

27. "Oil and Hazardous Materials Technical Assistance Data System," Division of Oil and Hazardous Materials, Office of Water Programs, EPA.

28. Personal communication, Ralph Wands, Director of Advisory Center on Toxicology, National Academy of Science, 1973.

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30. "Water Quality Criteria Data Book, Volume 1," Arhtur D. Little, Inc., December 1970.

31. "Water Quality Criteria Data Book, Volume 2," Arthur D. Little, Inc., July 1971.

APPENDIX C

POTENTIAL INDUSTRIAL PROCESSES PRODUCING HAZARDOUS WASTES

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TABLE C-1

POTENTIAL INDUSTRIAL PROCESSES PRODUCING HAZARDOUS WASTES

SIC	Industry	Waste Stream	Hazardous Constituents
01	Agriculture	Pesticide and Herbicide Contaminated Containers	Various Pesticides and Herbicides
08	Forestry	Pesticide and Herbicide Containers	Various Pesticides and Herbicides
10	Mining	From Laboratories or Plants using Lead	Lead Carbonate, Lead Acetate, Lead Nitrate
-	-	Waste Scavenging Catalyst	Copper Chlorides, Organics (diphenyl ether)
-	-	Old or Contaminated Thallium, Thallium Sulfate or Rodenticide	Thallium and Thallium Sulfate
1021	Copper Ores	Refinery Flues	Arsenic Oxides, Mercury
1031	Lead & Zinc Ores	Ore Wasting, Acid Wash	Mercury
1092	Mercury Ores	Extraction Wastes	Mercury
1099	Cadmium Ores	Cadmium Ore Extraction	Cadmium Amino Salts, Ammonium Salts
20	Food and Kindred Products	Waste Scavenging Catalyst	Copper Chlorides, Organics (diphenyl ether)
22	Textile Mill Products	Waste Scavenging Catalyst	Copper Chlorides, Organics (diphenyl ether)
-	-	Refinery Waters and Brine	Lead, Hydrochloric Acid
-	-	Waste From Chlorinated Solvent Reclaiming Operations	Sludge Containing Chlorinated Hydrocarbon
-	-	Chromate Wastes From Textile Dying	Chromates
-	Textiles	Certain Textile Cleaning Wastes	Mercury
2491	Wood Preserving	Sludges and Effluents	Mercury, Aliphatic & Aromatic Mercury Compounds, Creosote, Chlorinated Phenolics
-	-	Spent Wood Preserving Liquid	Pentachlorophenol
2499	Misc. Wood Products	Spent Wood Preserving Liquid	Pentachlorophenol
26	Paper and Allied Products	Refinery Waters and Brine	Lead, Hydrochloric Acid
-	-	From Manufacture of Lead Carbonate Paper	Lead Carbonate, Lead Acetate, Lead Nitrate
-	-	Waste Scavenging Catalyst	Copper Chlorides, Organics (diphenyl ether)
2611	Pulp & Paper	Dimethyl Sulfate Production Still Bottoms	Dimethyl Sulfate
28	Chemicals and Allied Products	Waste Scavenging Catalyst	Copper Chlorides, Organics (diphenyl ether)
-	-	Refinery Waters and Brines	Lead Hydrochloric Acid
-	-	Waste From Chlorinated Solvent Reclaiming Operations	Sludge Containing Chlorinated Hydrocarbons
2812	Alkalies and Chlorine Products	Chlorine Production Brine Sludges	Mercury Salts, Aliphatic & Aromatic Mercury Compounds, Asbestos, Lead, Chlorinated HC, Sulfuric Acid
2813	Industrial Gas	Waste Gases	Di, Penta, Decaborane, Nickel Carbonyl, Chlorine Trifluoride, Chlorine Penta-fluoride, Arsine

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TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
2813	Industrial Gas	Acetylene via Carbide Process	Calcium Hydroxide
-	-	Fluorine Production Wastes	Hydrogen Fluoride, Fluorine
2815	Industrial Organic Chemical	Acetaldehyde via Ethylene Oxidation	Acetaldehyde Still Bottoms, Organic Chlorides, Methyl Mercury Chloride
2815	Intermediate Organic Industrial Chemicals	Ethylene via Thermal Pyrolyses	Phenols, Organic Chlorides
2816	Inorganic Pigments	Chromates Wastes from Pigments and Dyes	Chromates (Cr^{+3}), Chromic Hydroxide Sludge, Diphenylamine, Dinitrotoluene, Nitrobenzene, Nitroaniline,Phosgene
2818	Industrial Organic Chemicals	Methanol Production Wastes	Organic Chlorides, Chromic Sulfate, Zinc Chloride
2818	Organic Chemicals	Off-spec Phenol	Phenol
-	-	Dinitrophenol Production Wastes	Dinitrophenol
-	-	Organic Processes Using Benzene - Cumene	Phenols, Benzene or Cumene
-	-	Cumene Oxidation and Phenol Production Wastes	Dichlorobenzene, Nichlorobenzene Tar
-	-	Contaminated Tetranitromethane	Tetranitromethane
-	-	Diphenylamine Wastes	Diphenylamine
-	-	Liquid (off-spec) Toluene Diisocyanate	Toluene Diisocyanate, Toluene
-	-	Off Grade Maleic Anhydride	Maleic Anhydride
-	-	Organic Liquid Contaminated Nitrobenzene	Nitrobenzene, Aniline, Chlorobenzene, Substituted Aryl Amine
-	-	Still Bottoms from Maleic Anhydride Manufacturing	Maleic Acid, Tars, Maleic Anhydride
-	-	Wastes from Manufacturing of Nitrochlorobenzene	Meta-nitrochlorobenzene, Para-nitrochlorobenzene
-	-	Waste Stream from Acrolein Manufacturing	Acrolein
-	-	Formaldehyde Production Wastes	Chromic Sulfate, Chloroform
-	-	N Butane Dehydrogenation	Chromic Sulfate, Sodium Sulfide
2819	Inorganic Chemicals	Cyanide Production Wastes	Sodium Cyanate, Sodium Cyanide, Hydrogen Cyanide, Mercuric Cyanide
2819	Industrial Inorganic Chemicals	Contaminated Antimony Compounds	Antimony Pentafluoride
2819	Industrial Inorganic Chemicals NBC	Hydrogen Bromide Wastes	Hydrogen Bromide
-	-	Manufacturing Wastes from Ammonium Silicofluoride	Fluoracetic Acid, Ammonium Silicofluoride
-	-	Manufacturing of Lead Nitrate, Acetate, and Carbonate	Lead Carbonate, Lead Acetate, Lead Nitrate
-	-	Manufacturing of Sodium Azide	Sodium Azide
2819	Industrial Inorganic Chemicals	Production Wastes Phosphorous	White or Yellow Phosphorous, Sodium Fluoride

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
2819	Industrial Inorganic Chemicals	Wastes from Fluoride Salt Production	Ammonium Fluoride, Ammonium Bifluoride, Potassium Bifluoride, Sodium Fluoride, Sodium Fluoride, Sodium Bifluoride, Hydrofluoric Acid
2819	Inorganic Chemicals	Sodium Dichromate or Potassium Chromate Production Wastes	Potassium Chromate, Potassium Dichromate, Sodium Dichromate
-	-	Wastes or Contaminated Perchloric Acid	Perchloric Acid
-	-	Barium Compounds	Barium Salts
2819	Industrial Inorganic Chemicals	Contaminated Fluorine	Silicon & Carbon Tetrafluoride, Hydrogen Fluoride, Fluorine
-	-	Arsenic Wastes from Purification of Phosphoric	Arsenic Sulfide, Hydrofluoric Acid
2821	Plastics Materials Synthetic Resins and Non-vulcanizable Elastomers	Residues from Manufacturing of Ethylene Dichloride, Vinyl Chloride	Various Amounts of Solvent, Chlorinated and Non-chlorinated Materials, Allyl Chloride, Methyl Mercuric Chloride
-	-	Cadmium Selenium, Pigment Wastes	Cadmium - Selenates, Selenium
2821	Polymers	Cellulose Ester Manufacturer	Sulfuric Acid, Mercury Chloride, Methyl Methacrylate
2821	Vinyl Resins	Vinyl Resins Manufacturing Wastes	Phenols, Carbon Tetrachloride Chloroform
2821	Plastics Resins Elastomers	Urethane Manufacturing Wastes	Mercury, Aliphatic Mercury Compound, Aromatic Mercury Compounds
2821	Synthetic Polymers	Liquid (off-spec) Toluene Diisocyanate	Toluene Diisocyanate, Toluene
-	-	Aqueous or Organic Liquid or Slurry Adiponitrile	Adiponitrile Polymer Solids, Hydrogen Cyanide, Phosgene
2822	Synthetic Rubber	Urethane Manufacturer Wastes	Mercury, Aliphatic Mercury Compounds, Aromatic Mercury Compounds
-	-	Aqueous or Organic Liquid or Slurry Adiponitrile	Adiponitrile Polymer Solids, Water or Organic Solvent, Hydrogen Cyanide, Phosgene
2822	Rubber Products	Nitrobenzene from Rubber Industry Wastes	Nitrobenzene
2822	Synthetic Rubber	Cadmium Selenium Pigment Wastes	Cadmium, Selenates, Selenium
-	-	Contaminated Antimony Compounds	Antimony Trifluoride, Antimony Pentafluoride
-	-	Rubber Manufacturing Wastes Retained Sludge	Polychlorinated Biphenyls, Selenium Diethyldithiocarbamate
2823	Cellulosic Synthetic Fibers	Rayon Fibers	Zinc Chloride, Cuprammonium Rayon, 2-blue Waters Copper, Sulfuric Acid
2824	Synthetic Fibers	Residues from Manufacturing of Ethylene Dichloride, Vinyl Chloride	Various Amounts of Solvent, Chlorinated and Non-chlorinated Materials, Allyl Chloride, Methyl Mercuric Chloride
2824	Synthetic Organic Fibers	Aqueous or Liquid Slurry Adiponitrile	Adiponitrile Hydrogen Cyanide, Phosgene

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
283	Pharmaceuticals	Organic Pharmaceuticals Wastes	Acetonitrite, Benzyl Chloride, Dichlorobenzene, Chlorobenzene, Toluene, Methanol, Methylene Dichloride, Pyridine, Tetrachloroethane, Trichloroethylene, Benzo-Tri-Fluoride, Chloro Sulfonic Acid
-	-	Pharmaceuticals Arsenic Wastes	Inorganic Arsenates, Organic Arsenates, Arsenylic Acid, Sodium Chloride
-	-	Miscellaneous Pharmaceutical Wastes	Diphenylamine, Phosgene, Mercury, Alphatic Mercury Compounds, Aromatic Mercury Compounds
2841	Soap and Detergent Manufacturing	Soap and Detergent Manufacturing Wastes	Nickel Sulfate, Zinc Sulfate, Hydrochloric Acid, Sulfuric Acid
285	Paints, Varnishes, Laquers, Enamels, and Allied Products	Solvent Based Paint Sludge	Lead, Chromium, Cadmium Selenium, Cyanides
-	-	Cadmium, Selenium, Pigment Wastes	Cadmium Selenates, Selenium
-	-	Water Based Paint Sludge	Chromium, Mercury
287	Agricultural Chemicals	Intermediate Agricultural Production Wastes	Nitric Acid, Sodium Chromate, Zinc Chloride, Hydrazine
2892	Explosives	Red Water Wastes, High Explosive Contaminated Solid Wastes and Waste Explosives	TNT, HMX, TDX, PETN, TETRYL, RDX, Dinitrotoluene
-	-	Nitrocellulose Base Propellant Contaminated Solid Waste and Waste Propellant, Smokeless Powder	Lead and Mononitroresorcinate, Nitrocellulose Alcohols, Nitrocellulose Acetates, Sulfuric Acids, Nitric Acid
-	-	Contaminated Tetranitro Methane	Tetranitromethane
-	-	Primary Explosives Wastes and Waste Explosives	(DDNPY) Diazodinitrophenol, (DPEHN) Dipentacrythritol-Hexanitrate, Lead Azide (dextrinated), Lead Styphnate (2,4,6, trinitro resorcinate) Mannitol Hexanitrate Mercury Fulminate, Potassium Dinitro Benzfuroxin (KDN BF), Silver Azide, Tetrazine Sodium Azide
-	-	Waste Nitroglycerin and Manufacturing Wastes	Sulfuric Acid, Nitric Acid, Nitroglycerin
-	-	Waste Pyrotechanics and Incindiary and Manufacturing Wastes	Phosphorous, Tungsten, Barium, Chromate, Lead Chromate, Potassium Perchlorate
-	-	Manufacture of Matches and Pyrotechniques	Lead Carbonate, Lead Acetate, Lead Nitrate, Barium Carbonate, Barium Nitrate
2865	Industrial Organic Chemicals	Dye Manufacturing Wastes	Copper, Chromium, Phenols Hydrogen Cyanide, Aniline, Disulfonic Acid
-	-	Chromates, Wastes from Pigments and Dyes	Chromates (Cr^{+3}), Chromic Hydroxide Sludge, Diphenylamine, Dinitrotoluene, Nitrobenzene, Nitroaniline, Phosgene

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
2865	Enamels, Inks	Cadmium - Selenium Pigment Wastes	Cadmium, Selenates, Selenium
2865	Wood Preserving and Industrial Organic Chemicals	Spent Wood Preserving Liquids	Pentachlorophenol
2869	Industrial Inorganic Chemicals	Contaminated Antimony Compounds	Antimony Trifluoride, Antimony Pentafluoride
-	-	Wastes from Manufacturing of Tetraethyl and Tetramethyl Lead	Tetraethyl Lead, Tetramethyl Lead
2869	Industrial Organic Chemicals	Contaminated PCB	Polychlorinated Biphenols
-	-	From the Manufacture of Chloropicrin	Chloropicrin
2879	Pesticides and Herbicides Manufacturing	Arsenic Pest and Herbicide Wastes	Calcium Arsenate, Copper Arsenate, Lead Arsenate, Sodium Arsenate, Zinc Arsenate, Manganese Arsenate, Arsenic Salt Mixture, Copper Acetoarsenite, Sodium and Potassium Arsenite, Zinc Arsenite, Lead Arsenite
-	-	Polychorinated Hydrocarbon Pesticide Wastes DOD	Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Methoxychlor, Lindane, DDD, DDT, Solvent (Benzene Xylene, Toluene), Phosgene
-	-	Phenyl Urea Herbicides	Diuron, Monuron, Linuron, Siduron, Chlorouron
-	-	Organophosphorous Pesticide Manufacturing DOD and Commercial	Methyl Parathion, Parathion, Demthon, Guthion, Mercaptans and Hydrogen Sulfide, Xylene, Phosphothioates, Malathion, Abate, Tetraethyl Pyrophosphate, Phosphorous Pentasulfide, Phosgene
-	-	Phenoxyherbicide Wastes	2,4-D, 2,6-D, Mono and Trichloro Phenoxy Acetic Acids, Solvents, 2,4,5-T
-	-	Carbonate Pesticide Manufacturing Wastes	Manganese Thiocarbonate, Zinc, Bux Ten, Carbaryl, Carbofuran
-	-	Agricultural Pesticide Arsenic Wastes	Arsenic Trioxide, Arsenic Acid
-	-	Benzoic Herbicide Production Wastes	Pichloram, Silvex, 2,3,6-TBA, Propanil
-	-	Chlorinated Aliphatic Herbicide Production Wastes	Dalapon, Randox, Trichloracetic, Acid (TCA), Trichlorobenzyl Chloride, Aromatic Solvents
-	-	Chlorinated Hydrocarbon Pesticide Production Wastes	Aldrin, Chlorodane, Dieldrin, Endrin, Heptachlor, Lindane, DDD, DDT
-	-	Miscellaneous Organic Pesticide Manufacturing Wastes	4,6-Dinitro-O-Cresol, 1,2-Dibromo-3-Chloro-Propane (DBCP), Nicotin, Pyrethrins, Rotanone, Warfarin
-	-	Mercuric Insecticide and Fungicide Manufacturing Wastes	Mercury, Aliphatic Mercury Compounds, Aromatic Mercury Compounds

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
2879	Pesticides and Herbicide Manufacturing	Halogenated Aliphatic Hydrocarbon Fumigants Manufacturing	Ethylene Bromide, Methyl Bromide, Methyl Chloride
-	-	Old or Contaminated Thallium Compounds or Rodenticide	Thallium and Thallium Sulfate
-	-	Manufacturing of Cacodylates	Cacodylates, Cacodylates Dimethylarsenic Acid, Cacodylic Acid and Sodium Salt
-	-	Contaminated Antimony Compounds	Antimony Pentafluoride, Antimony Trifluoride
-	-	Miscelleanous Pesticide Manufacturing	Isothalonite and Related Nitriles, Organic Solvents, Pyrethin, Sodium Fluoracetate
-	-	Pesticide and Herbicide Contaminated Containers	Various Pesticides and Herbicides
2899	Miscellaneous Chemical Products	Manufacturing of Electrical Match Head Type Fuses	Cuprous Acetylide
-	-	Contaminated PCB's	Polychlorinated Biphenyls
29	Petrochemicals	Petrochemical Wastes	Ethyl Benzene, Ethylene Dichloride, Tar, Thallium, Toluene, Chloric Acid, Nitric Acid, Ethylene Oxide, Vinyl Acetate, Formic Acid
29	Petroleum Refining and Allied Products	Petrochemical Wastes	Diphenylamine Tars, Toluene
-	-	Liquid Off-spec Isoprene	Isoprene
291	Petroleum Refining	Copper and Lead Bearing Waste	Lead Cyanides, Lead Nitrates, Copper Nitrate, Copper Cyanide
-	-	Petroleum Refining Aldehyde Wastes	Acetaldehyde, Butyl Aldehyde, Formaldehyde, Furfural
-	-	Refining Spent Caustics	Dinitro-o-Cresols Mercaptins, Phenol, Lead, Sodium Hydroxide
-	-	Petroleum Refining Sour Wastes	Hydrogen Sulfide, Mercury Mercaptans, Phenol, Ethyl Mercaptans, Cyanides
-	-	Miscellaneous Petroleum Refining Wastes	Benzene, Butadiene, Carbon Tetrachloride, Ethanol, Methanol, Allyl Alcohol, Butanol
2911	Petroleum Refining	Wastes from Gasoline Blending	Tetraethyl Lead, Tetramethyl Lead, Gasoline
2911	Petroleum Refining Jet Fuels	Jet and Rocket Fuel Storage and Wastes	Hydrazine
2911	Petroleum Refining	Still Bottoms (stored)	Arsenic Trichloride
-	-	Waste Brine Sludges	Lead Salts, Mercury Salts
2992	Lubricating Oils and Greases	Reclaimers Residues	Lead Oxide, Tetraethyl Lead, Cadmium, Tin, Antimony, Arsenic, Chromium
2999	Petroleum Products NEC	Off-spec Phenol	Phenol
3011	Tires	Rubber Manufacturing - Retained Sludge	Polychlorinated Diphenyls, Selenium Diethyldithiocarbamate, Nitrobenzene
3021	Footwear	Rubber Manufacturing Wastes retained Sludge	Polychlorinated Biphenyls, Selenium Diethyldithio-Carbamate, Nitrobenzene

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
3031	Reclaimed Rubber	Rubber Manufacturing Wastes - Retained Sludge	Polychlorinated Biphenyls, Selenium Diethyldithiocarbamate, Nitrobenzene
3041	Hose and Belting	Rubber Manufacturing Wastes - Retained Sludge	Polychlorinated Biphenyls, Selnium Diethyldithiocarbamate, Nitrobenzene
3069	Miscellaneous Rubber Products	Rubber Manufacturing Wastes - Retained Sludge	Polychlorinated Biphenyls, Selium Diethyldithiocarbamate, Nitrobenzene
31	Leather and Leather Products	Chrome Tan Liquor	Sodium Chromate
321	Flat Glass Manufacturing	Glass Etching Wastes	Hydrofluoric Acid, Hydrochloric Acid
322	Glass Containers	Etching Wastes	Hydrofluoric Acid, Hydrochloric Acid
323	Purchased Glass	Etching Wastes	Hydrofluoric Acid, Hydrochloric Acid
3231	Glass Products	Mirror Production Wastes	Chromic Sulfate
33	Primary Metals	Refinery Waters and Brines	Lead, Hydrochloric Acid
-	-	From Laboratories and Plants Using Lead	Lead Carbonate, Lead Acetate, Lead Nitrate
33	Primary Metals Industry	Waste Scavenging Catalyst	Copper Chlorides, Organics (diphenyl ether)
33	Primary Metal	Waste from Chlorinated Solvent Reclaiming Operations	Sludge Containing Chlorinated Hydrocarbons
331	Primary Metals	Metal Finishing Pickel Liquor	Sulfuric Acid, Hydrochloric Acid
331	Blast Furnaces Steel Works, Rolling and Finishing Mills	Steel Plant Waste Sludge	Phenols Sodium Cyanide, Sulfuric Acid, Chrome Sulfate, Zinc Chloride, Hydrochloric Acid
-	-	Iron Manufacturing Waste Sludges	Phenol, Sodium Cyanide, Ammonia
331	Primary Metals	Cold Finishing Wastes	Sodium Cyanide, Sodium Chromate, Zinc Chloride
3312	Coke Plant	Coke Plant Raw Waste Sludge	Phenol, Sodium Cyanide, Tar Acids, Ammonia, Thiocyanate, Hydrogen Cyanide
-	-	Stainless Steel Pickling Liquor	Hydrofluoric Acid, Sulfuric Acid, Chromium, Nickel, Nitric Acid
3312	Steel Works and Rolling Mills	Zinc Plating Wastes	Zinc Cyanide, Hydrogen Cyanide
3315	Steel Wire and Related Products	Wire Drawing Wastes	Copper, Chromium
3317	Tube Manufacturing	Tube Manufacturing Manganese Wastes	Potassium Permanganate, Copper Sodium Hydroxide
333	Refining, Non-ferrous Metals	Old or Contaminated Thallium Compounds or Rodenticide	Thallium and Thallium Sulfate
333	Non-ferrous Metals	Brass Mill Wastes	Copper Sulfate, Zinc, Sodium Dichromate, Sulfuric Acid, Bright Dip Liquor

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
3331	Smelting and Refining Nonferrous Metals, Copper	Smelting Wastes	Arsenic Trioxide, Selenium, Sulfuric Acid, Hydrochloric Acid, Copper, Lead, Mercury Antimony
331	Primary Copper	Copper Tube Extruding Waste	Copper, Nickel, Hydrofluoric - Nitric Acid
332	Smelting and Refining Non-Ferrous Metals, Lead	Smelting Wastes	Arsenic Trioxide, Selenium, Sulfuric Acid, Hydrochloric Acid, Copper, Lead, Mercury Antimony
3333	Smelting and Refining Nonferrous Metals Zinc	Smelting Wastes	Arsenic Trioxide, Selenium, Sulfuric Acid, Hydrochloric Acid, Copper, Lead, Mercury Antimony
3339	Primary Metals	Selenium, Thallium Production Wastes	Selenium, Thallium
-	-	Beryllium Production Wastes	Beryllium Powder, Beryllium Carbonate, Beryllium Chloride, Beryllium Hydroxide, Beryllium Oxide, Beryllium Selenate
3339	Primary Metals NEC	Nickel Ore Extraction	Nickel Sulfate, Sulfuric Acid, Hydrofluoric Acid
-	-	Nickel Alloy Manufacturing Sludges	Nickel Sulfate, Copper Sulfate, Sodium Fluoride, Sodium Hydroxide
-	-	Antimony and Antimony Tricxide Wastes from Smelting Industry Wastes	Antimony, Antimony Trioxide, Antimony Pentoxide
3399	Primary Metal Products NEC	Nickel Alloy Manufacturing Wastes	Nickel Sulfate, Copper Sulfate, Sodium Fluoride, Sodium Hydroxide
3351	Copper and Aluminum Rolling	Rolling Mill Wastes	Copper, Chromium, Sulfuric Acid, Bichromate
3351	Copper Rolling and Drawing	Copper Tube Extruding Wastes	Copper, Nickel, Hydrofluoric Acid, Nitric Acid
3357	Nonferrous Wire Drawing	Wire Drawing Wastes	Copper, Chromium
3362	Brass, Bronze and Copper Foundaries	Copper Tube Extruding Wastes	Copper, Nickel, Hydrofluoric Acid, Nitric Acid
3399	Primary Metal Products NEC	Copper Tube Extruding Waste	Copper, Nickel, Hydrofluoric Acid, Nitric Acid
-	-	Tube Manufacturing Manganese Wastes	Sodium Hydroxide, Potassium Permanganate, Copper
34	Fabricated Metals Industry	From Laboratories and Plants Using Lead	Lead Carbonate, Lead Acetate, Lead Nitrate
34	Fabricated Metals Products	Waste Scavenging Catalyst	Organic Diphenyl Ether, Copper Chlorides
-	-	Finishing Effluents	Copper Cyanide, Nickel Cyanide, Zinc Cyanide, Sodium Dichromate, Chromic Hydroxide, Zinc Ferrocyanide
347	Metal Finishing	Metal Cleaning Wastes	Nitric, Hydrochloric, Sulfuric Acids, Cyanide Chromium Cadmium, Oxalic Acid
347	Metal Finishers	Plating Preparation	Chromium, Hydrofluoric Acid
3411	Metal Cans	Zinc Plating Wastes	Zinc Cyanide, Hydrogen Cyanide

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
3451	Bolts, Nuts, Screws, etc.	Zinc Plating Wastes	Zinc Cyanide, Hydrogen Cyanide
3471	Plating	Alumium Anodizing Bath with Drag Out	Chromium, Sulfuric Acid
-	-	Brass Plating Wastes	Copper Cyanide, Zinc Cyanide, Hydrogen Cyanide, Zinc Phosphate, Zinc Chromate
-	-	Cadmium Plating Wastes	Cadmium, Cadmium Cyanide, Hydrogen Cyanide
-	-	Chrome Plating Wastes	Chromates (Cr^{+6}), Chromates (Cr^{+3}), Sulfate, Chromic Hydroxide Sludge
-	-	Cyanide Copper Plating Wastes	Copper Cyanide, Hydrogen Cyanide
-	-	Silver Plating Wastes	Silver Cyanide, Hydrogen Cyanide
-	-	Acid Copper Plating Wastes	Copper Sulfate, Sulfuric Acid
-	-	Nickel Plating Wastes	Nickel Chloride, Nickel Sulfate
-	-	Pyrophosphate Copper Plating Wastes	Copper Pyrophosphate
-	-	Tin Plating Wastes	Hydrogen Fluoride, Stannic Chloride, Stannous Chloride
-	-	Phosphate Sludges from Metal Coating Open	Lead, Manganese, Nickel
3479	Coating Engraving and Allied Services	Aluminum Anodizing Bath with Drag Out	Chromoum, Sulfuric Acid
-	-	Zinc Plating Wastes	Zinc Cyanide, Hydrogen Cyanide
3479	Metal Coating	Metal Finishing Pickel Liquor	Sulfuric Acid, Hydrochloric Acid
-	-	Phosphate Sludges from Metal Coating Operations	Nickel, Lead, Manganese
36	Electrical and Electronic	Electronic Circuitry Manufacturing Wastes	Potassium Ferrocyanide, Lead Chromium, Hydrocyanic Acid, Sulfuric Acid, Carbon Tetrachloride Chloroform
3612	Transformers	Contaminated PCB's	Polychlorinated Biphenyls
3632	Refrigerators and Freezers	Refrigeration Equipment Manufacturing Wastes	Chromates, Heavy Metals, Acids
3662	Radio-TV Transmitting Signal Detection Equipment and Apparatus	Electronic Tube Production Wastes	Mercury, Barium Compounds, Hydrogen Fluoride
3671	Electron Tubes Receiving Type	Electronic Tube Production Wastes	Mercury, Barium Compounds, Hydrogen Fluoride
3672	Cathode Ray Television Picture Tubes	Electronic Tube Production Wastes	Mercury, Barium Compounds, Hydrogen Fluoride
3673	Electron Tubes Transmitting	Electronic Tube Production Wastes	Mercury, Barium Compounds, Hydrogen Fluoride
3674	Semiconductors	Semiconductor Manufacturing Wastes	Boric Acid
3679	Electronic Components NEC	Magnetic Tape Production Wastes	Ammonium Dichromate, Chromic Oxide, Ethylene Dichloride

TABLE C-1 (Cont'd.)

SIC	Industry	Waste Stream	Hazardous Constituents
3691	Storage Batteries	Battery Manufacturing Sludges	Cadmium Carbonate Hydroxide, Lead Sulfate, Arsenic, Antimony
3692	Primary Batteries	Mercury all Wastes	Mercury
-	-	Battery Manufacturing Sludges	Cadmium Carbonate Hydroxide, Lead Sulfate, Arsenic, Antimony
3555	Printing Machinery	Graphic Arts Photography Leather	Ammonium Chromate
-	-	Rotogravure Printing Plate Wastes	Chromium
3555	Printing Trades Machinery	Duplicating and Photo Equipment Manufacturing Wastes	Selenium, Arsenic, Arsenic Triselenide
3573	Electronic Computing Equipment	Computer Manufacturing Wastes	Sodium Cyanide, Sodium Ferricyanide, Sodium Ferrocyanide, Hydrofluoric Acid, Cadmium Chromate, Thallium
3579	Office Machines	Duplicating and Photo Equipment Manufacturing Wastes	Selenium, Arsenic, Arsenic Triselenide
3585	Refrigeration Machinery	Refrigeration Equipment Manufacturing Wastes	Chromates, Heavy Metals, Acids
3721	Aircrafts and Parts	Aircraft Plating Wastes	Cadmium Cyanide, Sodium Cyanide, Sodium Hydroxide
3724	Aricraft Engines and Engine Parts	Aircraft Plating Wastes	Cadmium Cyanide, Sodium Cyanide, Sodium Hydroxide
3728	Aircraft Equipment NEC	Aircraft Plating Wastes	Cadmium Cyanide, Sodium Cyanide, Sodium Hydroxide
4	Transportation	Pesticide and Herbicide Contaminated Containers	Various Pesticides and Herbicides
-	-	Railroad Engine Cleaning	Sodium Chromate, Diesel Fuel, Alkaline Cleaner
-	-	Arsenic Wastes from Transporation Company	Arsenic Oxide Powder
491	Utilities	Utilities and Electric Station Wastes	Polychlorinated Biphenyls (PCB)
-	-	Electronic Services and Combined Utilities Steam Supplies	Arsenic Trichloride Scavenged from Coal Power Plants